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Institutions and Technology

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The purpose of this Conference was to review the state-of-the-art on urban erosion and sediment control. This conference brought together many individuals with a great deal of expertise to discuss soil erosion and sediment problems, in the urban centers, fringe areas, and sattelite growth centers. It also focused attention on land management techniques, social and institutional structures, and other mechanisms by which soil erosion and water problems may be reduced to acceptable levels.

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PROCEEDINGS
NATIONAL CONFERENCE ON URBAN EROSION AND SEDIMENT CONTROL: INSTITUTIONS & TECHNOLOGY

Held
October 10-12, 1980
at
ST. PAUL, MINNESOTA

William L. Downing
Editor

Published by

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EDITOR'S PREFACE

William L. Downing, Ph. D.,
Professor of Biology, Hamline University;
Supervisor, Ramsey Soil and Water Conservation District

Thirty-five years ago, in 1945, Hugh Bennett framed our topic:

> *"The only way in which water pollution due to erosion silt can be effectively controlled is by the adoption of soil- and water-conservation practices."*

The keynoters of this Conference, from their diverse backgrounds, previewed the dialogue that was to illuminate the subsequent days:

> *"While much progress has been made, the road ahead is long, steep and often poorly mapped."*
> --Joseph Krivak, U. S. Environmental Protection Agency

> *"The problems of urban runoff and erosion are yet to be solved...What strikes me is not our lack of information about its cause and remedies, but how little we do about it."*
> --Frank Beal, Illinois Institute of Natural Resources

> *"As much as two billion tons of sediment is deposited every year in the Nation's stream systems...That makes sediment the country's greatest single water pollutant by volume."*
> --Norman Berg, U. S. Soil Conservation Service

> *"...only about thirty percent due to natural erosion, the remaining seventy percent the result of...human activity... Construction contributes ten percent of the total sediment tonnage...Private construction..., road, street and highway construction produce similar problems."*
> --Gerald Willet, Minnesota State Senate

> *"If we regulate the home-building industry to control erosion, but don't do anything about the other problems ...we're really not going to do much good."*
> --George Kirkpatrick, National Association of Home Builders

> *"In five states, legislatures have adopted programs to provide cost-sharing assistance for installing erosion and sediment control measures...In two of these states, such cost-sharing is authorized for urban areas."*
> --Lyle Bauer, National Association of Conservation Districts

As each keynoter broadened the picture from his perspective, the points of agreement, add the points of controversy, emerged clearly:

"As I look to the legislative future of urban erosion and sediment control, I see...a system of state guidelines... which can be incorporated into local regulations."

--Willet

"Regulation can, does, and should play a central role in urban erosion and sediment control."

--Beal

"The regulation of urban erosion has been about as effective as shoveling snow with a pitchfork...54% of our metropolitan area municipalities do not have erosion and sediment control ordinances."

--Willet

"There are regulations which set standards and there are those which specify management or operating procedures...Standards that use such language as 'its natural or undeveloped state', or, 'maintain the integrity of the natural drainage patterns seem particularly fluffy."

--Beal

"Make the ordinances as flexible as possible, so we can build on the areas that are best to build on, and preserve the areas that are most environmentally dangerous."

--Kirkpatrick

"We must demand that environmental programs produce the greatest environmental benefit possible for the least amount of money... I do not believe that environmental movement in this country can afford to slip into a comfortable middle age."

--Krivak

"The financial burden is borne by the local communties...many of these costs are unnecessary, since much of the damage can be prevented."

--Berg

"Every time the cost of housing goes up a thousand dollars, we are probably eliminating the opportunity for two to three million people in the United States, to be able to buy a home."

--Kirkpatrick

"These communities are saying that the cost of increased runoff is to be borne by the development itself, and the control of runoff is to be done at the site itself."

--Beal

"Should those engaged in construction or similar land-disturbing activities be entitled to cost-sharing, tax benefits, or other incentives for installing required erosion and sediment control measures?"

--Bauer

> *"If developers are involved in the beginning, most of them will listen, because they are beginning to understand that they've got to listen."*
>
> --Kirkpatrick

"Help every builder and developer in America adopt and follow a code that promotes urban land conservation and reduces erosion and sedimentation...We need to help change the institutional framework."

--Berg

> *"You have the talent at this Conference to provide many of the technical answers and management needs...the political, social, environmental, and engineering hurdles...We still know far too little."*
>
> --Krivak

The following days at the Conference showed Joseph Krivak's assessment to be substantially correct: that the talent was present at the Conference, and it continuously surfaced in the three different Curricula that were presented on October 11, and in the Case Studies on October 12.

The Program Chairman of the Conference, Leonard C. Johnson, with the tireless work of Jay Feldman, and with help from the rest of the Planning Committee, assembled a program that began with the general questions such as those excerpted above, then provided a series of answers, and then looked at the way the problems are being solved in some localities.

The use of concurrent sessions on October 11 made it impossible for any one person to obtain all the information from the Conference, as Robert Thronson points out in his Evaluation, but the availability of these Proceedings diminishes that disadvatange, and it was felt by those in attendance that the procedure had overreaching advantages to the participant.

The organization of the Conference lent itself to a subject-area presentation rather than chronological Proceedings, and therefore all general Keynotes are presented first, then each Curriculum is presented as a unit rather than divided up into time intervals, and finally the Case Studies.

The Technical Curriculum started with Richard Highfill's overview of techniques used to control urban erosion, and then went into detail on methods that participants had either found useful or were proposing for further study: how and why to use retention basins, how the use of wetlands can help urban erosion, methods and reasons for stream resoration, ways and legal considerations involved in controlling erosion in developing residential areas, cost-effectiveness of erosion control at construction sites, incentives and constraints involved in innovation in erosion control, and the use of concrete grid pavements. No transcript of Darrel Morrison's discussion on the use of native vegetation was available, but the abstract is re-printed here.

The Regulatory Curriculum began with Mary Garner's summary of the evolution and current status of erosion and sediment control regulatory laws in the United States, which went so rapidly at the Conference that participants will be pleased to have the chance to read it at leisure. The details of regulation unfolded during the day, with presentations on regulation of erosion in a suburbanizing area, a compilation of the development of comprehensive erosion control and stormwater management ordinances, a consideration of the development of such ordinances from an urban viewpoint, the effect of regulation on building procedures, the setting of standards for soil sediment pollution abatement, how a Conservation District can be involved in erosion and sediment control during development, the use of self-regulation as an alternative to legislation, and the Iowa law which affects both rural and urban erosion and which can be used as a model by other States. William L. Church's summary was provided through his cooperation, and although his institutional analysis of local ordinance adoption is appropriate for longer treatment, I am peased to have at least the summary here.

The Local Implementation Curriculum began with Boris Lang on expediting the review process, not available for the Proceedings, and then expanded into discussion of comprehensive community planning to control urban erosion, the use of soils information in the planning process, the role of water research institutes in erosion control, the development of local urban erosion control ordinances, the urban provisions of a State Cost-Share program, the costs of managing a construction site runoff program, multijurisdictional stormwater management, Toronto's approach to urban erosion and sediment control, and control in a mountainous region.

The Case Studies, which filled the morning of October 12, brought together participants from many scattered places, working within their own state laws and their own local ordinances, showing what can and cannot be done under particular conditions and restrictions. These diverse presentations from Pennsylvania, Maryland, Virginia, New Jersey, Georgia add California, can be of great value to those concerned with urban erosion and sediment control, in their own development of techniques, rationales, payment, and regulation.

This was the first National Conference to emphasize practical means of controlling soil erosion and sedimentation on urban land developments and construction sites, viewed from the points of view of the state laws, ordinances, experts in soils, and the builders themselves. Thus it brought together people of widely divergent backgrounds, who spent three days with familiar and unfamiliar topics and participants, converging together on a subject of importance to America.

Twelve national and state groups worked together to bring about this Conference, and encouraged their members and employees to attend:

United States Environmental Protection Agency
United States Department of Agriculture
National Association of Conservation Districts
National Association of Home Builders
National League of Cities
Soil Conservation Society of America
Urban Land Institute
Minnesota Soil and Water Conservation Board
Minnesota Association of Soil and Water Conservation Districts
Wisconsin Association and Board of Soil and Water Conservation Districts
Minnesota Pollution Control Agency
Metropolitan Council of the St. Paul - Minneapolis Area

The Committee hopes that the communication at this Conference will foster new cooperative efforts among those it brought together, to give rise to a full range of effects, from appropriate legislation, to new types of programs, to new methods that can be applied to the disturbed land and water in urban areas.

ACKNOWLEDGEMENTS

Leonard C. Johnson, Chairman of the Planning Committee
Wisconsin Board of Soil and Water Conservation Districts
1815 University Avenue, Madison, WI 53706

On behalf of the agencies and organizations that sponsored this conference, and the members of the planning committee, I wish to express sincere appreciation to all of the conference participants and especially to those who presented papers for publication in this document.

It is our hope that this publication will help to disseminate widely the useful information presented at the St. Paul Conference; and foster widespread development and implementation of effective local programs to control stormwater runoff, soil erosion and sedimentation in urban areas.

I take this opportunity to acknowledge with deep gratitude the following people, who in many ways contributed generously of their time and knowledge in planning and presenting this conference. Not least among their contributions was the positive and mutually supportive attitude which pervaded the work of the planning committee.

Steven W. Pedersen, formerly a staff member of the Minnesota Soil and Water Conservation Board, and who played a major part in initiating the conference and worked very effectively as co-chairman of the committee before taking a position with the Minnesota Water Planning Board on July 1, 1979.

Jay Feldman, Assistant Director for Land Use and Development.
National Association of Home Builders

Robert E. Williams, Special Projects Director
National Association of Conservation Districts

John Peterson, Nonpoint Source Branch
U.S. Environmental Protection Agency

Donald Urban, Water Division, Region V
U.S. Environmental Protection Agency

Gerald R. Calhoun, President
Soil Conservation Society of America

Max Schnepf, Editor
Soil Conservation Society of America

William Parker, Chief, Resource Planning Branch
U. S. Soil Conservation Service

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Warren Zitzmann, Community Planner
U. S. Soil Conservation Service

Harry Major, State Conservationist
U. S. Soil Conservation Service

Warren Curtis, Assistant State Conservationist
U. S. Soil Conservation Service

James Lesley, Assistant State Conservationist
U. S. Soil Conservation Service

George C. Haase, Chairman of the Urban Lands Committee & President
Wisconsin Association of Soil and Water Conservation Districts

William Downing, Chairman, Urban Committee
Minnesota Association of Soil and Water Conservation Districts

Marylyn Deneen, Member of the Minnesota Soil and Water Conservation Board, and Director, Minnesota Association of Soil and Water Conservation Districts

Leonard Pikal, Chairman
Minnesota Soil and Water Conservation Board

Greg Larson, Program Specialist
Minnesota Soil and Water Conservation Board

Michael Flitter, Staff Representative
Minnesota Soil and Water Conservation Board

Marcel Jouseau, Environmental Planner
Metropolitan Council of the Twin City Area

Mary M. Garner, Legal Consultant
National Association of Conservation Districts

Dorothy Bryan
National League of Cities

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Minnesota Government Training Service

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INTRODUCTORY REMARKS

Marylyn Deneen, Supervisor
Ramsey Soil and Water Conservation District
St. Paul, Minnesota

Welcome to the Conference, and to the City of St. Paul. We hope that you will have a pleasurable visit and that your educational experience will be great.

The City of St. Paul covers only about a third of the area in Ramsey County, but the remainder of the County is rapidly urbanizing. Although we can still identify fourteen active farms in the County, our District has many urban problems. The Supervisors encountered great frustration when our District was founded in 1973 as the last in Minnesota, trying to meet the urgent needs for the soil and water in this urbanized county, within a system that was more accustomed to rural, farm, problems. We spoke wherever we could be heard about the erosion and sediment control problems we encountered, and in response to our needs and those of others all over the country who have similar problems, the first National conference on the subject was organized. This is that conference.

We are pleased that you are here. We want to thank especially the Environmental Protection Agency, the National Association of Conservation Districts, the Wisconsin and Minnesota Soil and Water Conservation Boards, and the eight other agencies that are sponsoring the event. We would also like to express our thanks to the hard-working committee that started many months ago, planning this Conference; Leonard Johnson, Program Chairman, and Bill Downing, Conference Coordinator.

They have brought us up to this point in time. Now it's up to us, the participants, the presenters, and the moderators, to actively involve ourselves in this Conference, to take advantage of the opportunity to exchange ideas on urban erosion and its effect on water quality.

I'd like to share with you a few pieces of data on who you are and where you come from. We wanted this to be a National Conference, but it is an International Conference, because we have people representing two of the provinces of Canada, in addition to 25 states. We represent the territory from the State of Washington to Washington, D.C., and from Canada to Florida.

This week celebrates St. Paul's 125th Birthday, and our industrious Mayor has been traveling all around the City, taking in all kinds of events, and blowing out candles. We feel it is great that he is here to welcome us to the Conference.

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WELCOME

George Latimer, Mayor
City of St. Paul

I think that this subject, and your gathering of disciplines to discuss it, are terribly important. It is shocking to me, as it must be for you, that we are all about twenty-five to thirty years late in exchanging information about erosion, and water, and water quality control, in the urban area. It has been the focus of rural and agricultural concerns for most of this century, but the effect on our environment is most dramatic in the city.

I expect, without being a specialist in your area, but with several years' work in development matters, that like so many other areas of development in this country, that institutional response is about a quarter of a century behind the problem. We may well understand the nature of the subject you are studying from technical, engineering, and ecologic and scientific points of view, but I don't think our institutions have yet geared up to responding to what we already know, and so we are even now, in this blessed country, and in this distinguished urban area, and among highly-enlightened citizenry, in a day-to-day fight with the suburbs about what happens to the run-off water from a suburban development.

We need to create an institutional framework within which to address the issues that are involved in this topic. Until we really have something with teeth in it, I think we are going to continue in the American way -- I don't mean that in the usual patriotic sense, but rather in the permitting development to go on within each jurisdiction, as though the consequences were limited to the here and now, rather than the there and later. Your work is terribly important, I mean that most seriously. I am sure that people from my staff will be auditing your panels, and I am very grateful for that, for the products of your thinking and your work and for inviting me to talk to you for a minute.

Welcome.

MODERATOR'S OPENING

William H. Greiner
Executive Vice President
Soil Conservation Society of America

I appreciate the opportunity to participate in this conference to discuss a topic that is of importance to all of us, urban erosion, a topic that has perhaps not been given the attention it should have received in the past. I think it was natural to focus our thoughts and attention on erosion of farm and ranch lands, from a production of food and fiber standpoint, but erosion from development lands in urban areas causes other problems, related to water quality.

Many states are looking at this problem of urban erosion and its resulting consequences. My home state of Iowa began to seriously question what erosion from all areas was doing to water quality and land degradation in the late 1960s and early 1970s. The Iowa General Assembly tried to pass erosion control legislation in 1969, and again in 1970, tied entirely to rural erosion. Not until 1971, when erosion from all sources was included in the legislative bill, was it passed.

The bill that was passed includes erosion from both rural and urban areas, including all construction sites. It provides a penalty, after due process, for allowing this to occur, if a complaint is initiated by a damaged party. This legislation is a story in itself, and I don't intend to pursue it any further today. It does, however, indicated what one state is doing to combat the ever-increasing problem. Other states are taking similar actions, and enacting erosion control legislation, some from rural areas, some from urban areas, and some from both.

The Soil Conservation Society of America, with whom I am now affiliated, recognizes that wise use and management of land is necessary to meet present, near-term, and long-term future needs. We need adequate supplies of food, forest products, minerals, water, energy, and space for people to work and recreate, while at the same time natural areas are preserved and land is protected from erosion.

We must also realize that continuing pressure on our land base will occur, as population increases. Current projections forecast a population of some 263 million in the United States, and 30 million in Canada, by the year 2000. Accommodating this increase will require significant increases in housing, energy, transportation, and other activities associated with the uses of land. These uses of land will require land-disturbing activities, and the process will expose more land to erosion hazards from both wind and water.

This is the first National Conference ever held to emphasize practical means of controlling soil erosion and sedimentation on urban land, development and construction sites. This conference will bring together many individuals with a great deal of expertise, to discuss soil erosion and sediment problems, in urban centers, fringe areas, and satellite growth centers. It will also focus attention on land management techniques, social and institutional structures, and other mechanisms by which soil erosion and water problems may be reduced to acceptable levels. I am very happy to have a part in the sessions.

PUBLIC INVOLVEMENT IN URBAN EROSION AND SEDIMENT CONTROL PROGRAMS

Joseph Krivak
Deputy Director, Water Planning Division
Environmental Protection Agency, Washington D.C.

In our society, life becomes more complex with each passing day. There was a time when we looked forward to the splendid relief of rain. Now it washes toxics into our waters -- kills fish -- reduces crop yields -- affects human life itself. The rain itself is becoming more acid. The amazing igenuity of our scientists and modern chemistry promised a future of limitless bounty -- now we discover that bounty may contain deadly poisons -- many of them generated in urban areas.

As the true costs of progress become known there is a growing interest in water quality management. More and more emphasis is being placed on control of nonpoint sources as their contribution to water quality degradation becomes better understood.

The initial phase of the Section 208 water quality management program is almost completed. The initial plans have confirmed that nonpoint source problems are significant. There are many technical, institutional and political gaps which have to be filled if we are to meet our water quality goals.

This conference will address many of these issues. While much progress has been made, the road ahead is long, steep and often poorly mapped.

You, in this room, are dedicated to traveling that road. You understand the complexity of the problem, the need for better information, better financing, and more effective methods. You know the problem can be alleviated, but you also know the size of the task.

For example, the ultimate solution to urban wastewater problems may lie in major changes in the way our society lives, works and travels.

However, for those of us who belive environmental policy must accommodate man and his environment, this course is neither practical nor politically acceptable.

Congress knew when it passed the Clean Water Act in 1972 that the number and diversity of discharges from nonpoint sources would be overwhelming and that they could not be subjected to the same type of regulatory mechanism established for communities and industries. They knew that the runoff from agriculture, construction, surface stormwater, and other nonpoint sources would require local management and regulation; rather than the application of a certain type of technology at the end of a pipe.

I don't think they quite knew the complexity, the political, social, environmental, and engineering hurdles we would have to jump in order to achieve our goals. We still know far too little.

The Environmental Protection Agency is taking some concrete steps to better define the problems of nonpoint pollution and test some of the possible solutions. There is a particularily important program underway in the area which concerns your conference.

EPA has initiated a nationwide urban runoff program to establish an up-to-date and accessible data base on the various urban watershed problems and management methods.

Thirty studies will be conducted nationwide in order to cover a wide range of varying climatic regions and problems. But, most important, studies like these aim to establish critical links at the local level between planning and implementation of management programs.

This conference is another valuable means of exploring the problem and considering solutions. You are discussing structural and non-structural controls; designs for multi-purpose use; and some of the best management practices. You will be discussing ways to increase public awareness of the problem and public acceptance of the treatment.

In your public involvement concerns you have the full support of the Environmental Protection Agency.

The Clean Water Act recognizes local political support as a key ingredient in the process. To further emphasize public involvement and its importance in decision-making, we have issued regulations which will assure that the public participation process will be allowed to work. Further, the Section 208 program provides for a great deal of flexibility in the kinds of decisions made at the local and State levels.

Some have criticized a policy that allows so much local discretion and it is true that some management agreements have taken advantage of the volunteer nature of the law and some local government entities have not utilized 208 monies in the best possible manner.

We regard 208 as a test of the capacity of the partnership among Federal, State and local governments. I hope it will demonstrate to Washington that localities and States are capable of planning and regulating environmental management problems on their own.

It is a test to see if the heavy metals and other toxics carried by stormwater and other nonpoint means can be controlled locally. It is a test to see if our urban rivers can be truly clean for swimming again because of local decision-making. If it doesn't work -- if all good reasons for allowing local control on nonpoint pollution programs fail to establish concrete results -- a signal will be sent that the present program needs substantial revisions.

As far as we are concerned, the verdict is still out as to whether or not new Federal regulatory authority may be needed. But we want the local programs to work. We want regions to deal with problems effectively -- and in the manner the regional characteristics dictate.

Significant progress has been made -- depending on what is counted -- 20 States or more have urban erosion and sediment control programs. There has been enough experience to know that they work. You will hear about some of those programs in the next few days. Pay special attention to:

- **How the programs were developed**
- **How they received public support**
- **How they garnered political support**
- **How they are managed**
- **How they are supported financially**

Out of all the alternatives presented to you -- there is some combination that can best fit your local or State needs.

The public participation embodied in the 208 program can be an effecive tool in exploring those alternatives and in selecting the one best suited to meet your needs. Most importantly the public involvement will be critical to enlisting the political support required to get the program adopted. That is the most compelling reason to make sure your public involvement process work.

I say "must" because in my judgment there is not sufficient political support for an environmentally responsible alternative if the 208 program fails.

Krivak

Although this conference was called to explore alternatives for urban erosion and sediment control programs. I would like to explore some larger environmental issues with you. Recently we have had a lot of questions raised regarding the environmental policies and programs in our Nation. There is at least one alternative -- seriously proposed by powerful and sincere men and women in Washington and around the country -- which is being considered. That alternative is to do nothing.

Some of those people want us to declare victory against water pollution and scale back our goals. Others who have supported these programs in the past are asking whether we can continue to afford spending in a time of budgetary restraint.

We supporters of environmental progress increasingly are going to find ourselves expending precious political capital to protect even the modest gains we have made. Environmental considerations may be brushed aside in the name of energy -- or budget process -- or jobs or fighting inflation.

I believe the average citizen feels just as strongly today as ten years ago that the environment is worth preserving, that our resources of air and water are just as precious as our oil. But his message is not being delivered often enough or effectively enough.

In fact, organized environmental groups sometimes seem as interested in attacking their allies as their enemies. Political organizations are not being used as effectively as they could be for environmental purposes.

I do not believe the environmental movement in this country can afford to slip into a comfortable middle age. For sound environmental policy to survive, it must retain the capacity to improve and reshape itself as new information is received. We must also demand that environmental programs produce the greatest environmental benefit possible for the least amount of money. We must keep our facts at hand and our powers of persuasion sharp.

I hope you will not confuse my assessment with our resolve. We can continue to make environmental progress in this country. I am certain we must.

In summary: You have the talent at this conference to provide many of the technical answers and management needs.

You have the experience of many people who have developed and are conducting good programs.

You have the common sense approach that is needed to develop workable programs.

I hope you leave with the resolve to get the job done at the local and state levels.

LAND USE SHIFTS AND A QUALITY ENVIRONMENT

Norman A. Berg, Administrator
USDA Soil Conservation Service

We have come a long way in conserving soil and water resources in the two decades since my Soil Conservation Service career brought me to the Washington, D.C., area.

Your conference is:

. A recognition of that progress;

. An acknowledgment of the many groups who are--or should be--involved in soil and water conservation; and

. Evidence of your commitment to further refining the "science and art" of checking the problems of urban soil erosion and sedimentation.

SCS has a broad mission of natural resource conservation. Dr. M. Rupert Cutler, USDA Assistant Secretary for Natural Resources and Environment, recently stated that "we must restore and maintain all of our natural resources...an objective requiring full use of the biological, social, and physical sciences." Therefore, we are as concerned about the effects of soil erosion and sedimentation around America's cities and along transportation corridors as we are about those same problems on farms and ranches.

Through the Soil and Water Resources Conservation Act of 1977, USDA is looking at several major concerns or "potential problem areas." One of them relates to sediment effects on water quality and another on the need for sound soil and water resource management in urbanizing areas.

In "urban conservation," our record is good, but we still have a long way to go.

I would like to talk about where we have been, where we are now, and how to get where we want to go...how to concentrate or target our efforts.

In 1960, as I shifted my SCS career to the national office, my new home State of Maryland and its neighbor Virginia were experiencing increasingly heavy pressure for community growth and transportation around the Nation's Capital and around other major centers.

There was a matching increase in dissatisfaction on the part of soil conservation districts in both States over what the growth was doing to

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the construction sites themselves and to the surrounding countryside. Maryland and Virginia conservationists were among the first to realize that it might not be necessary for urban newcomers to wade through ankle-deep mud to inspect model homes.

They advocated and helped create countywide and then Statewide programs for urban soil erosion and sediment control that were--and are--pioneering models. Maryland's sediment control law was enacted in 1970, and 7 years later the D.C. Department of Environmental Services adopted an ordinance modeled after it...A Northern Virginia district leader became a national advocate for sediment prevention...Maryland's districts began "urban conservation tours"--they had their 13th tour this month. Their tours and seminars became increasingly popular for people in other Piedmont States and then for many others.

These early leaders began with showing the problems and challenges--and now they are demonstrating the techniques that are in place and working well.

In 1967, I co-chaired a National Conference on Soil, Water, and Surburbia held in Washington, D.C., and co-sponsored by the U.S. Department of Agriculture and HUD.

Since then, there have been:

. A National Conference on Sediment Control in Washington, D.C., sponsored by HUD;

. A comprehensive guidebook on principles and practices that county governments as well as conservation districts helped prepare;

. A model State act for soil erosion and sediment control developed by the Council of State Governments with the aid of conservation districts and SCS;

. A land-use symposium in Omaha, Nebraska, sponsored by the Soil Conservation Society of America; and

. Action in a number of States to develop erosion and sediment control programs.

The problems are still with us.

Every day, more than 8,000 acres of agricultural land are being converted to urban uses--such as new homes, highways, shopping centers, schools, and industrial parks. That totals nearly 3 million acres each year.

Berg

As many of you know firsthand, development on such a massive scale involves extensive disturbance of the land. Protective vegetation may be reduced or removed, excavations made, topography altered, removed material stockpiled--too often without protective cover--and the physical properties of the soils changed permanently.

These alterations also may permanently affect the on-site drainage and storm runoff patterns. The result? Construction sites that are marred by rilled and gullied slopes, gullied waterways and channels, washed roads and streets, undercut pavements and pipelines, clogged storm sewers, flooded basements, and debris-laden work areas.

The extent of this type of damage is illustrated by a 10-year study in Montgomery County, Maryland, conducted by the U.S. Geological Survey. It showed that soil erosion from construction sites ranged from 16 to 226 tons per hectare.

Erosion is not the only source of damage. The increased runoff erodes streambanks and channels and causes flooding below the construction site. And the sediment pollutes streams, lakes, and reservoirs and damages the area where it comes to rest.

As much as 2 billion tons of sediment is deposited every year in the Nation's stream systems; half a billion tons reaches the oceans. That makes sediment the country's greatest single water pollutant by volume.

Much of this sediment comes from areas undergoing urban development. I co-chaired a 6-year international Great Lakes water quality study, in part of which we looked at some urbanizing watersheds, including the Menomonee River in Wisconsin. One major finding was that developing urban areas released five times as much suspended sediment per acre as the worst cropland.

Water quality management plans being developed in response to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) must address these problems of urban nonpoint source water pollution before the plans can be approved by the Environmental Protection Agency.

EPA's concern--and ours--is that sediment lowers the quality of water for municipal and industrial uses and for boating, fishing, swimming, and other recreational activities. It increases the wear on equipment, such as turbines, pumps, and sprinkler irrigation systems. It carries with it--or absorbed on it--pesticides, phosphates, and other chemical pollutants.

Sediment almost always damages the area where it is deposited--

burying lawns, filling ditches, clogging storm sewers, culverts, and drains. It can make an area unsuitable for use as a park or playground. It reduces the storage capacity of reservoirs and may fill small ponds and lakes. It can block navigation channels and fill harbors and estuaries. It can be harmful to game and shellfish.

Damage from sedimentation nationwide has been estimated at half a billion dollars a year. Not all of this, of course, can be attributed to land undergoing urban development, but the amount that can is high in proportion to the acreage.

The financial burden is borne by the local communities, either through higher taxes or direct expenditures by homeowners. Many of these costs are unnecessary, since much of the damage can be prevented.

Planning is the keyword. Construction sites should be chosen carefully on the basis of soil surveys and other information. If soil hazards are known before construction begins, special compensating designs can be prepared in advance or alternate sites can be selected. Nearly any site can be made suitable for most uses if enough money is spent, but avoiding really poor sites helps keep construction and maintenance costs at a minimum.

Erosion and sediment control measures should be planned to fit the particular needs of each site. They should be included as a regular part of construction planning, along with a sound maintenance and follow-up program. Follow-up is important because erosion and sedimentation cannot be effectively subdued without thorough, periodic checks of the conservation practices.

The practices--adapted from agriculture, research, and land user/conservationist teamwork--include erosion control and sediment trapping devices and runoff management systems.

The specific principles and techniques for checking erosion and sedimentation, which I have explained more thoroughly in an attachment to my printed remarks, are basically the same ones that SCS and conservation districts have used in rural areas for four decades or more. After all, soil and water problems respect no manmade boundaries, and many of the solutions work equally well on the farm or ranch and at the edge of town. Some look a little different--but the function and the functioning are about the same.

Yet, while there have been relatively few new technical breakthroughs-- one of the latest is a "silt fence" made of synthetic fabric--we have made tremendous progress in other areas, such as translating technical ideas into specific guidelines. Beginning with the National Association of Counties guidebook in 1970, many States have developed their own standards and specifications for controlling erosion, sedimentation, and stormwater runoff.

We have made progress in many States in drawing up, enacting, and fine-tuning legislation or cooperative programs to address urban erosion and sedimentation. In some of these States, a developer must submit an acceptable erosion and sediment control plan to county or State officials before he or she gets a go-ahead to begin construction. The plan may be prepared either by the developer's own engineering staff or by a consultant. In many of these States, soil and water conservation districts have review responsibilities with technical help from SCS.

In other States, builders and developers may ask for technical assistance without any legal requirement to do so and without a strong cooperative program in place. I hope that soil and water conservation is becoming a standard part of the construction business.

We have made progress as well in building a body of research information about which conservation techniques work in controlling urban erosion and sedimentation and which don't--and why. The U.S. Department of Agriculture's Science and Education Administration has a number of scientists engaged in conservation research. One part of their effort is to study how sediment is detached, transported, and distributed in streams, rivers, and reservoirs.

They are developing techniques and procedures for predicting and controlling sediment, such as petroleum-based chemicals, porous asphalt, buffer strips, and the use of sludges and composted solid wastes.

They are also working on a mathematical model to help States identify and control nonpoint source water pollution--including sediment eroded from construction sites.

We have made progress in helping builders and developers install permanent stormwater management facilities--that can control urban erosion and sedimentation long after the bulldozers and concrete forms have gone.

Finally, we have made progress in creating scenic, environmentally sound highways. Back in the 1960's, SCS worked with the Bureau of Public Roads in designing an interstate highway system that would incorporate sound principles and techniques of erosion and sediment control. Today, we work with a number of State highway departments, helping them to develop conservation plans before construction.

For all the tremendous strides that America has made in checking erosion and sedimentation, there are a few hurdles yet to be overcome.

First, more local officials need to follow sound principles of land use planning. The land that is best suited for urban development based on physical characteristics probably is prime farmland. Should it be used for urban construction? That is a question that must be examined carefully by landowners, developers, local governments, and planning agencies together.

If prime farmland is not used for urban development, then an increasing proportion of construction sites will be on sloping lands, thus creating new challenges for developers and planners in design and construction methods.

Second, more local and State governments need to make erosion and sediment control a stated policy. Local officials need to assume their share of the responsibility for managing the natural resources of their communities.

Every State is affected by erosion and sedimentation. Yet, only 20 States, plus the District of Columbia and the Virgin Islands, have any legislation to address these problems. I think this is our greatest challenge today--to get the legislation or guidelines in place. After all, technology is not much without a workable delivery system for it.

Third, erosion and sediment control techniques need to be cost-effective. Expensive concrete structures should not be used where straw bales can do the job just as well.

In the planning stage, the cost of each measure should be compared with the degree of protection required for the site and the degree that probably will be obtained. If the cost of necessary protection exceeds the anticipated damage or potential loss--in either monetary or environmental terms--the basis for the plan should be reexamined and a more cost-effective solution sought.

The developer passes the costs for checking erosion and sedimentation on to the homeowner--if the plan is sound, then the costs are minimal and they probably are offset by benefits, such as lower taxes for highway maintenance and flood prevention.

Fourth, more private citizens and communities, as well as the industries associated with urban development, need to become aware that erosion and sediment control is possible, is necessary, and is in their best interest as well as their environment's. Together we need to muster the support to turn recommendations and regulations into effective conservation in place on the land.

Despite our years of emphasis on erosion and sediment, not enough people know that help is available. We need an aggressive information program that involves all of us and all media.

Fifth, we need to help change the institutional framework surrounding urban erosion and sediment control. For conservation districts--which are legally responsible under State law for soil and water conservation--this may mean obtaining the funds to hire people for training contractors, developers, and inspectors. These people need to understand not only the simple mechanics of erosion and sediment control, but also the reasons behind the mechanics.

In many cases, the contractor or developer doesn't really know what the practices are supposed to do, only that some regulation says they must be used. Then the practices may not be constructed properly and will not perform the job they are supposed to do. A recent study showed that half of all construction sites in one State still had inadequate control measures because of lack of inspection during construction and improper maintenance afterwards.

Institutional changes are needed through and beyond the design professions and regulatory or voluntary-assistance agencies. They are needed in the perception of financial institutions and the legal profession.

Sixth, we must help every builder and developer in America adopt and follow a code that promotes urban land conservation and reduces erosion and sedimentation. It would follow these basic principles:

a. Use soils that are suited for development and are not needed for food and fiber production.

b. Leave the minimum amount of soil bare for the shortest possible period of time.

c. Reduce the velocity and control the flow of runoff.

d. Detain runoff on the construction site in order to trap sediment.

e. Release runoff safely to downstream areas.

Builders and developers should strive for a "conservation architecture," one that gives full consideration to the natural landscape of an area.

The Soil Conservation Service and its local conservation district partners offer assistance to planners, developers, builders, agency staffs, and anyone else who must cope with urban problems of erosion, sedimentation, water supply and disposal, improper land use, and flooding.

We can help with guidelines for controlling erosion and sedimentation on land developed for highways, subdivisions, shopping centers, airports, and other urban uses. The result can be cleaner streams and reservoirs and lower road maintenance costs.

We can offer information about soils and their potential or limitations for housing, recreation, waste disposal, road construction, and many other uses in addition to agriculture and forestry.

We can provide standards for installing or constructing erosion and sediment control devices, and advise on water supply potential, recreation sites, and resource development trends. Here in St. Paul, for example, SCS provided technical assistance in restoring the streambank through Battle Creek Park.

Urban soil erosion and sedimentation can be controlled if we all work together. The tools are here--we have only to use them effectively to build prosperous, attractive, and environmentally sound communities.

Your conference and the information that will result from it are important educational happenings. May the sharing of fresh, innovative ideas be productive and enjoyable.

PRINCIPLES AND PRACTICES FOR REDUCING URBAN EROSION AND SEDIMENTATION

Urban erosion and sedimentation can be effectively reduced by careful land use planning and by using established principles and practices.

Basic principles:

1. Choose the land that has the optimum natural drainage pattern, topography, and soils for the intended development.
2. Set parks and other open space uses on areas that have soils not well suited to intensified development.
3. Save trees and other existing vegetation wherever possible.
4. Keep the area of soil exposed and the duration of exposure to a minimum.
5. Hold lot grading to a minimum.
6. Plan streets to fit the contour of the land, avoiding long stretches of grade.
7. Provide adequate drainage to storm sewers or other runoff disposal systems so water does not erode the land or flood property below the construction site.
8. Use temporary vegetation or mulch to protect critical areas exposed during development.
9. Build basins to trap sediment from surface runoff.

Attachment to remarks by Norman A. Berg, Administrator, USDA Soil Conservation Service, at the National Conference on Urban Erosion and Sediment Control: Institutions & Technology, St. Paul, Minnesota, October 10, 1979.

10. Release runoff safely to downstream areas. This may involve installing stormwater management systems to keep the rate of runoff the same during and after development as it was before.

11. Install permanent vegetation and structures as soon as possible for continuous protection.

Based on these principles, a set of erosion control practices, sediment trapping devices, and runoff management systems have come into successful use.

Erosion control practices include keeping the soil covered with temporary or permanent vegetation or with various mulches in order to retard soil blowing or washing. Temporary mulching materials may be straw, hay, wood chips, bark, shells, hulls, stone, jute mesh or netting, synthetic fabrics, plastic netting, or asphalt--or a combination of these. For permanent cover, gravel, stone, or concrete blocks may be used--typically in combination with grasses, shrubs, and trees in open areas or along borders.

Special grading methods, such as roughening a slope on the contour or tracking with a cleated bulldozer, help trap moisture, seed, and fertilizer. Grass springs up first in these grooves, then spreads to adjacent areas.

Diversions intercept surface runoff from areas uphill from construction sites, preventing water from reaching the bared soil. Terraces and benches are similar to diversions, but their purpose is to break up slope length. Without them, runoff would flow from top to bottom downslope, picking up speed as it moves and accelerating erosion.

Grade stabilization structures, such as pipe drop inlets, pipe slope drains, and drop spillways, control the grade and prevent head cutting in natural or artificial channels.

Grassed waterways--natural or constructed outlets of suitable vegetation--dispose of excess surface runoff. Where vegetation is not suitable, waterways may be lined with concrete, mortared stone, or riprap.

Underground outlets or storm sewers, commonly made of corrugated plastic, clay, and concrete, are used to intercept, collect, and convey runoff water. In developed areas, where large quantities of water need to be moved, surface drains or open channels often are used.

These practices are designed to prevent soil erosion and resulting sedimentation. They are the first line of defense. Yet, no matter how rigorous the effort to prevent soil movement, it is an elusive goal. There will be some soil erosion, particularly during severe storms. Thus, an attempt must also be made to confine sediment-laden water to the construction site and to settle out or filter out sediment from runoff before it leaves the site.

Sediment trapping devices include vegetative filters and sediment basins and traps. Vegetative filters--"living strips" of suitable vegetation--remove sediment, organic matter, and other pollutants from runoff. To be effective, the water must go through the vegetation, not over it. Studies at Purdue University have shown that an 8-foot filter strip can trap up to 80 percent of all fine sediments passing through it from an 80-foot-wide eroding area.

Sediment basins collect and store water-borne sediment or debris.

Contrary to what conservationists thought in the past, these basins are more efficient if they are kept full of water. If this is impractical for safety or health reasons, the pool should be drained as slowly as possible. If properly planned, installed, and maintained, sediment basins are ideal sites for wildlife habitat.

Sediment traps are smaller than sediment basins and are used in areas of less than 5 acres. They often are built in conjunction with small dikes to exclude runoff from adjacent undisturbed areas and to force all the runoff from the disturbed area through the trap.

Runoff management (or stormwater management) systems control excess runoff caused by development or changes in land use. They usually are applied on the construction site to prevent channel erosion downstream from the area--a condition which could cause flooding.

The flooding danger in particular has caused many government agencies to adopt ordinances or regulations requiring developers to provide floodwater storage for the increased runoff, based on the estimated runoff from a particular storm or from storms of different frequencies.

Runoff management systems usually involve some type of detention structure or infiltration device, such as dams, excavated ponds, infiltration trenches, perforated parking lots, parking lot or rooftop storage, and underground tanks. Some are similar to structures built on farmland or in small watershed projects; others look and act quite differently than these more familiar rural sights.

Ponds are one of the most practical and versatile means of controlling runoff. They can be used as a sediment basin during development and then converted to a multiple-use pond--proving recreation for residents as well as continuing runoff management. One drawback: Ponds require more land surface than other methods; so they are not practical where real estate values are high, unless residents place a high value on open water areas.

Infiltration trenches usually are filled with stone and should be used only if the water entering them is very clean and the soils are permeable. Parking lot runoff, for example, would not be acceptable because of its oil content, which would gradually prevent the soil from absorbing moisture.

A major drawback of this system is that maintenance is virtually impossible. When one of these trenches fails, it must be completely reconstructed.

Parking lot and rooftop storage areas may be needed to help control runoff from pavement.

These principles and techniques are basically the same ones that SCS and conservation districts have used in rural areas for four decades. Some look a little different--but the function and the function_ing_ are about the same.

# # # #

EXTRACTS FROM
QUESTION-AND-ANSWER SESSION

Q: Mr. Berg, do you perceive the SCS taking on a different role in the future, becoming less a local assistance and voluntary type of organization, and more a regulatory one?

A: BERG: The role of SCS, a federal agency, is to work through conservation districts, and state agencies, so whatever we do on this, it would be a multi-government approach. We are primarily a technical corps of people that can provide the professional disciplines needed.

In water quality, people are going to have to respond, or be in violation of standards that have been adopted. In the surface mining area, the Department of the Interior is administering the Act, but we are being asked to join them on how to restore the soil to its original productivity.

In the sediment area, in Maryland the local Conservation District signs off on the type of plan to be carried out, and the County employs inspectors to follow up and do the actual on-site determination as to whether the plan is being followed. I have been to meetings in my local conservation district, and our District Conservationist, engineer, the District Conservation Board, and the County inspectors sit together; so we are in a twilight zone.

In the Great Lakes report we said that in these knotty problems we should examine what's on the books in terms of regulatory action. Voluntary approaches need to be encouraged to the fullest; there is a great deal of need for education, and additional incentives to get people to do what should be done; but we recommended that we examine the total problem, and identify the proper role of each level of government. I think that the responsibility for soil erosion regulation rests heavily with state and local governments, and we will continue to be an agency providing the best possible technical backup that we can. We will continue to advocate certain matters within our charter, for example about what's happening to our prime land and concern about practices that lead to excessive soil erosion and sedimentation, regardless of where they occur.

Q: Mr. Krivak, in your speech you said 208 is coming of age, that EPA feels it is not possible to control all sources of runoff and erosion and that control must be on the local level. Has EPA decided that you can't do the job from Washington D.C., and you've got to come out to we local districts and local landowners and get some help?

A: KRIVAK: EPA in 1970 started out as almost a purely regulatory agency because we basically had one probram, municipal construction, together with a few enforcement activities. After the 72 Act it took two or three years for the EPA policy on nonpoint sources to mature, to recognize that little federal regulation in that particular area was feasible, and there was hope in the nonpoint area, it lay at the state and the local level. I think EPA has fully recognized that in either a regulatory or a voluntary program, public support for any program is essential. It is hard to predict what may happen, but EPA policy for the last two or three years has been one of very strongly looking to the local and state level, in the nonpoint source area, for program direction, for program leadership and for program management; and philosophically I don't see that changing. That's why it is very important that we in the environmental area have the kind of support that is needed at the local level to get these things done.

I assume there are a lot of planners here. I would say this in the nicest sense, that planners are expendable, they have one job to do, to get the information to the public and the local political officials, so they can make the right kind of decisions. Planners have an important but a limited job. If they plan in a vacuum, if they don't have the support of the citizenry, if they don't have local political support, whatever they do in urban runoff is not going to succeed. I guess that's why we are putting a lot of stress on the public involvement area.

Q: Two questions concerning changes in EPA's program of incentives and disincentives to get all states and local governments to act.

A: KRIVAK: Now that 20 states have developed state regulatory programs, I believe that soon we will reach the watershed where the majority of the states will have recognized the problem and will have acted. We may not need a state regulatory program in some states, these without large urbanizing areas and they may be better off if they put their environmental legislation into areas where they do have particular problems.

If you are asking what EPA sees down the road in the next few years in terms of changes from a national or a federal standpoint, I don't see any major changes even being considered in national water pollution control legislation, prior to perhaps 1983. This date has been tied into the goals of the Act, providing a period to look back to see what progress we made, collectively. I think Congress had that as a benchmark date.

Q: I am from an urban Soil and Water Conservation District. When our District first formed, we looked at cost-share programs associated with the SCS, and found that many of them did not apply to urban areas. So while there is technical assistance, unless I am mistaken in our assessment of the federal programs, there aren't the kinds of cost-share programs available to urban areas, that are available to rural areas. Mr. Berg, do you see anything coming on the national level that would cost-share in the urban areas?

Q: and A: Session

A: BERG: You are absolutely right. The Agricultural Conservation Program of USDA, administerd by ASCS, is limited by law to farm, ranch and forested areas. The one cost-share program that the SCS administers applies only to designated counties in the ten states of the Great Plains subject to wind erosion. There are some features of the Watershed Protection and Flood Prevention Act, offering cost-sharing as an incentive, that we're going to test in small watersheds. We have asked for authority to deal with cost-sharing in Resource Conservation and Development Projects, but it has so far not been passed by Congress. The Culver Amendment to the Clean Water Act is dedicated to rural clean water problems. And except for the contributions that have come from non-federal actions, either through states, counties or other sources, activities have been primarily in the non-urban area. One of the strategies being studied for the future in the Resources Conservation Act is what you are asking for: to find what is needed to deal with soil erosion and sedimentation problems that affect water quality. Some helpful ideas could be generated here.

They will be competitive dollars, because the people dealing with the rural cost-share programs are saying now that there is more demand than they have funds. We have a problem in deciding how much money can be dedicated to this purpose. If it can be demonstrated that it's in the public interest to cost-share in urban areas, then there may be a case for public input of tax dollars. We are dealing with the private sector here, and are operating with forces that are much more difficult to deal with than if we were dealing with public land. Our public land problems are substantial too, and that includes how we deal with public sites dedicated to urban uses. We've made great progress in our transportation system, but there is still a big need there.

KRIVAK: Your question was very perceptive. During the House Committee oversight hearings, we went to some length to describe the rural clean water program and the rural cost-sharing programs, and the Chairman, who came from an urban area, suggested that a cost-sharing program on urban runoff would gain a lot more political support than our rural program. So people are thinking about it.

Q: (Inaudible question. Answers deal in the time schedules combined sewer overflow, federal regulation, and added personnel)

A: KRIVAK: I can give you a short answer. The schedule is Now. However, neither the agency nor most states are prepared to write very substantive permit conditions relating to stormwater and separation of sewers. We don't know all the answers — treatment is not an answer because of the cost. If I had to make some guess on what will happen, it is that the first permits will be general ones covering large areas, perhaps even an entire state, and the first conditions will be related to best management practices rather than to effluent criteria or effluent standards.

Q: and A: Session

BERG: We already know how many people we can have in the SCS for this fiscal year: 13,656, one more than last year. I can't begin to tell you what we're going to have in the 81 era. We are going through a process of assessment, examination, public participation, and alternative strategy examination, to help determine the future. An agency such as ours, working as we do with federal personnel ceilings, will be a bottleneck without putting additional resources into this work. We have suggested the need for funding at the national level, and that money might even be transferred to state and local organizations to employ competent people. Already the Districts of this country have over 5000 person-years dedicated to soil and water conservation work, and that will be part of the answer, but state and local governments are also facing a level in the number of persons that they have assigned, so we're also looking at contracting as the best way of doing it, engaging the private sector as far as possible. For the soil and water conservation needs of the future, we need to explore every possible alternative and idea that we can get, and the group, here ought to offer some.

THE ROLE OF CONSERVATION DISTRICTS IN URBAN EROSION AND SEDIMENT CONTROL

Lyle Bauer
President
National Association of Conservation Districts

It is a real pleasure for me to be with you today representing the National Association of Conservation Districts (NACD) and the 2950 districts across America.

NACD's interest in urban erosion and sediment control is real, of long standing, and is growing. To illustrate this, I want to review the creation of districts, their purposes, their emerging challenges, and how they fit into the urban conservation scene.

In 1935 the Soil and Water Conservation Domestic Act (Public Law 74-46) created the Soil Conservation Service (SCS) within the Department of Agriculture to develop and execute a continuing program of soil and water conservation. The linkage between soil erosion and water pollution was recognized in that original legislation. The Act declared that the "wastage of soil and moisture resources on farm, grazing, and forest lands of the Nation, resulting from soil erosion, is a menace to the national welfare and that it is...the policy of Congress to provide permanently for the control and prevention of soil erosion..." Such a policy, the Congress stated, would "...preserve natural resources, control floods, prevent impairment of reservoirs, and maintain the navigability of rivers and harbors..."

Responding to the Congressional challenge demanded a two-fold effort. New scientific knowledge on the causes and cures of soil erosion and water pollution was needed and, more importantly, this knowledge had to be relayed in practical, usable form to every farmer, rancher, and land user in America. This led to the search for an institutional framework that could be effective in involving people in the conservation cause.

The Secretary of Agriculture's Committee on Soil Conservation proposed "That on or after July 1, 1937...all erosion control work on private lands...be undertaken by the Soil Conservation Service, only through legally constituted Soil Conservation Associations." From this idea was born the Soil Conservation District.

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To get the needed legislative action for the new soil and water conservation focus, President Roosevelt sent letters to state governors transmitting a model soil and water conservation district act. Every state, Puerto Rico and the Virgin Islands passed laws creating conservation districts. The formation of local districts began immediately, and by 1945, SCS Chief Hugh Bennett could report to Congress that 1415 soil conservation districts had been organized, and that "other districts are being organized steadily, indicating that the country will soon be covered with (them)." Bennett's prediction has, for all practical purposes, been achieved. Nearly 3000 districts now cover over 99 percent of the Nation.

Make-up and Responsibilities

These local units of state government are governed by local citizens and exist independent of, but partner to, the resource conservation programs of the federal government. Although the original purpose was erosion and sediment control, the district movement has grown to include new goals and authorities and provide new services to private land users and local units of government. Through a memorandum of understanding, signed by each district and the Secretary of Agriculture, the Soil Conservation Service provides technical assistance to the district and its cooperating land users. Thus, the national goal of soil and water conservation is translated into local action programs designed to fit local conditions and needs.

Through conservation districts, the knowledge of skilled technicians is combined with the practical experience of land users to develop conservation plans tailored to the land and water resources as well as the user's skills and desires. Plans are based on locally-developed technical standards which, in turn, rely on soil surveys, water resource studies, and a broad range of natural resources research. In this way, both national concern and the latest scientific technology can be brought to the attention of the land user and, through the planning process, incorporated in his decisions on the use and management of the land.

The conservation district, in addition to receiving applications from and providing services to individual land users, operates a local conservation program that includes information and education, encouragement of needed research, eliciting cooperation and input from various local, state and federal agencies, and providing services on natural resource matters to local units of government. In carrying out this program, one of the main roles of the district is to provide a sense of local priorities and guidelines so that many different programs can be efficiently allocated to meet the most pressing local problems. Districts provide, for many local jurisdictions, what amounts to a natural resources department of local government.

Districts have banded together, at the state and national levels, in private non-profit associations that can convey district needs, priorities and viewpoints in a coordinated fashion. In addition to the 52 state and territorial associations, the National Association of Conservation Districts provides similar services on the national level. With headquarters in Washington, DC, 5 regional service offices, and a service department located in League City, Texas, NACD speaks for districts, provides an on-going service capability to assist them in their work, and conducts studies on natural resource subjects of interest and value to the improvement of district programs.

Districts and Water Pollution

Water quality has been an integral part of conservation district programs from their inception. Hugh Bennett's philosophy, as expressed to a Congressional Committee in 1945, was, and still is, a basic tenet of soil and water conservation districts:

> The only way in which water pollution due to erosion silt can be effectively controlled is by the adoption of soil- and water-conservation practices applied in accordance with the needs and capabilities of the land.

Areas of Concentration

Today, district programs still focus on the prevention of soil erosion and the control of water pollution. The 1979 Policy Position of the National Association of Conservation Districts lists the following 8 priority areas for district programs:

(1) The protection of the resource base and prevention and control of nonpoint source pollution. This includes the prevention of soil erosion and the control of pollution from pesticides and herbicides, fertilizer nutrients, animal wastes, storm-water runoff and sediment.

(2) Comprehensive resource management on a watershed basis. This includes the utilization of all techniques, structural and nonstructural, to conserve and develop soil, water, forest and wildlife resources within watershed units for all beneficial purposes.

(3) Reclamation of areas previously and presently disturbed by mining for all minerals.

(4) Improvement in the management of private, nonindustrial forest lands.

(5) Encouragement and incorporation of environmental education in schools.

(6) The preservation and enhancement of prime agricultural, range, pasture, forest and horticultural lands. This includes management of grass or grazing lands for proper grazing.

(7) Participation in the land-use decision process by providing resource inventories, soils information, problem identification and technical assistance.

(8) Reclamation of areas previously and presently disturbed by urbanizing and industrial development. This includes sedimentation, erosion and stabilizing of roadsides.

The "Voluntary" Philosophy

With this background and philosophy, it was only natural that districts would become a part of the nation's major assault on water pollution as it grew out of the environmental concerns of the early 1970's. There were differences, to be sure, between the district philosophy and the new federal effort. This approach was felt by most district officials to be not only valuable, but essential to success in gaining the cooperation of private land users. Much of the new federal effort to control water pollution was based on regulatory methods, and this gave district officials serious concern.

District officials are chary about programs that are solely regulatory in nature. They fear that there could be a widespread rejection of regulation on the part of affected citizens. This would introduce added costs, fail to meet water quality goals, and threaten many of the gains that had been painstakingly achieved over the 40 years of the soil conservation movement.

After much debate and discussion, districts chose to take an active role in the new pollution control efforts. By so doing, they brought the conservation district's voluntary approach to bear on the problem of nonpoint pollution control. This has resulted, since 1972, in an ever-increasing coordination between conservation district programs and water pollution control programs emerging from federal legislation that affect both urban and rural lands. In five states, legislatures have adopted programs to provide cost-sharing assistance for installing erosion and sediment control measures. In two of these states, such cost sharing assistance is authorized for urban areas although this phase has not yet been implemented.

The basic components needed in a voluntary or non-regulatory program are efficient administration, research data, an ongoing information and educational effort, technical assistance, and cost-sharing for the most expensive practices. The only difference in a regulatory program is the addition of regulatory authority in those cases where it is locally determined to be needed.

Conservation Districts in Urban Areas

As urban erosion and sediment problems began to multiply with the rapid growth and spread of urban, residential, business, industry, and transportation areas, municipalities and counties turned more and more to districts for technical expertise and assistance. Urban areas not originally included within conservation districts are being included by changes in state laws or by petition.

It is now estimated that of the 17,000 soil conservation district officials serving nationwide, about 70% are farmers and ranchers and 30% are educators, business people, professionals, housewives, and other urban and suburban people.

The interest in urban conservation has grown to the point that just this year, 1979, we in NACD established an Urban Conservation Committee. This committee is just now developing a charter to present to our Council. It will give special attention to soil erosion and sedimentation in urban areas along with such conservation problems as other aspects of water quality, shoreline erosion, stormwater management, urban forestry, open space, and conservation education.

District Involvement in Erosion and Sediment Control Legislation and Programs

It was over 10 years ago that a few individual conservation districts became concerned about and involved in urban erosion and sediment control programs. Joining with city and county governments, districts assisted in developing local ordinances and in implementing their provisions. Today erosion and sediment control laws in 19 states, Puerto Rico, the Virgin Islands and the District of Columbia have evolved from this modest beginning.

Mary Garner, Legal Consultant to NACD, will present a detailed statement on the provisions of this legislation in one of tomorow's sessions.

Areas of Concerns

There are several area of concern I would like to discuss.

First, conservation district involvement has been largely in the area of assessment of local problems, technical assistance, plan review, and consultation with county and city governments carrying on the regulatory functions. This seems to be a logical arrangement, although there are exceptions where local districts actually carry on some of the enforcement provisions such as inspections, handling of complaints, issuing stop work orders, etc. Each local district and others concerned must answer the question, "What should be the role of the local conservation district in a regulatory program?"

Second, farmers and ranchers can not recover the costs of applying conservation measures on their land in their marketing systems. Since these practices result in off-site benefits, it has been commonly felt that the federal or state governments should provide cost-sharing assistance.

At the same time, it has been generally felt that builders and construction firms could recover the costs of required erosion and sediment control measures in their contract or home sale prices and, therefore, public cost-share funding was not necessary. With the price of housing going up as rapidly as it is, coupled with the increasing contribution of land preparation to that housing cost, this may no longer be true. Should those engaged in construction or similar land disturbing activities be entitled to cost-sharing, tax benefits, or other incentives for installing required erosion and sediment control measures?

Third, conservation districts obtain technical assistance from the US Department of Agriculture, primarily from the Soil Conservation Service. Some states and counties provide funds to districts to enable them to employ clerical assistance and conservation technicians. In spite of that effort, technical assistance is still a problem in most conservation districts, and is felt by many district officials to be the limiting factor in achieving conservation on farms and ranches. As the demands for conservation technical services from state and urban governments grow, how can districts obtain the added funds and personnel to respond to this need without reducing badly needed assistance to farmers and ranchers?

And finally, erosion and sediment control programs require a high degree of cooperation and coordination between conservation districts, county and city governments, and the affected operators and landowners. Mutual understanding, trust, and dedication to principles and objectives are absolutely essential. How can this atmosphere best be created and maintained among all concerned parties so that erosion and sediment can be controlled within practical limits and to the general satisfaction of the participants and the public?

Conclusion

These and many other questions will be examined in this seminar. NACD is pleased to be one of the sponsoring organizations. Through these kinds of sessions, and more importantly, through subsequent deliberations at each local level, practical and sound programs can be forged whenever needed. NACD and conservation districts across America look forward to working toward that goal.

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THE ROLE OF THE BUILDER IN URBAN EROSION AND SEDIMENT CONTROL

George Kirkpatrick, Jr.
President
Kirkpatrick Builder, Inc.
Gainesville, Florida

I am filling in for Vondal Gravlee, the President of the National Association of Home Builders, who is absent because his Board of Directors meeting was re-scheduled due to Hurricane Frederick. The National Association of Home Builders is an association of about 120,000 corporate members. At our national convention last year in Las Vegas, we registered about 64,000 delegates, with about 23 acres of exhibits under roof. We have almost 800 local associations throughout the different states, and many of you have probably worked with home builders association representatives in the past. We are making efforts to be in on the early planning, in the beginning of regulations as they impact our industry.

The home building industry is the second largest industry in the United States; only agriculture is larger. Its importance to our economy was shown in the 1974-1975 recession. One of the things that caused it to be so severe was the collapse of the home building industry, which drove unemployment up tremendously. In 1979, the estimated production of housing in the United States is 1,643,000 units. If part of those are multi-family units, and the average lot is 10,000 square feet, that means that in 1979 we will develop about 337,000 acres. I want you to think about that number for a minute. The little lady out front asked me if I needed any audio-visual aids, and I told her, no, I would handle my own, so I'd like to handle that now. (unscrews a light bulb)

Today in the United States we have somewhere around 1,044,000,000 acres in active crop production. If you divide that by 337,000 you get 2769. That means it would take us two thousand seven hundred and sixty-nine years at the rate that we are developing land today for residential use, to cover as much land as is under crop production today. That's longer than we have been keeping records. My main point is that I want to make sure that we bring into focus the size of the home building industry and the amount of land that we use and develop, as it relates to the overall erosion and sediment problem. We are tremendously concerned about the overall problem, but I think that if we regulate the home building industry to control erosion, but don't do anything about the other problems--mining, forestry, farming, and so on, then we've really not going to do much good in soil erosion and sediment control. About the only effect you're going to have is turning off that light over there compared to all the rest of the lights in this room.

The builder's goal is to try to do something to stem the tremendously increasing cost. Our mission is a mission of service. Almost all of us live in a house, and unless we're going to go back to living in caves and tents, somebody is going to have to provide the housing for this country.

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We need to work together, to end this polarization that we've had between our industry and local government, state government, regional government, and the regulatory agencies. It's been a real bloodletting over the past 5 or 6, 8 or 10 years, depending on the area of the country you're from. Some areas of the country you still don't have much regulation on the home building industry, but those are areas where it is not of great impact.

It is the homebuilding industry that ultimately will have to implement and comply with any kind of regulations that are developed in soil erosion and sediment control. I'm asking you when you go back home to your various agencies, or when you go back home to your universities and you write another paper or whatever your function is here to day, that you take that point into consideration. And that you also take into consideration the fact that we do have an important mission in this country, and that is to provide the housing. Every time the cost of housing goes up a thousand dollars, we are probably eliminating the opportunity for two to three million people in the United States, to be able to buy a home. The people it impacts the most are probably the poor; the minority groups, and the young. Most of us either are young, or have some young folks at home. They're not going to be able to have that one dream that's true of America all over the country, and has always been true, to own their own home, if things continue to go the way they are going today.

Government regulation is not the only thing that has increased the cost of housing, but it has added to it. And in the past, in a lot of instances, it was unnecessary regulation, or regulation carried to an extreme, or over-reaction that produced something we couldn't deal with. We need to get through that stage of our development as a country, and get on with the business of cooperating with each other in trying to do something to preserve our natural resources and provide housing.

The median sales price of a house today is about $64,000. About 25% of that unit cost is in the land. That cost has escalated from about 12%, 15 years ago. In addition to the actual construction costs are the different kinds of regulations. Delays are unbelievably expensive. When you're paying 14½% on your construction loan today, and you go through a 2, 3, 4, 6 month delay, a 2-year delay in some project, it becomes so expensive that it can't take place.

In some areas of the country these controls are used to control growth. The Clear Water Act, the 208 water management plan, and the concepts surrounding the clean water legislation, were not designed to be a no-growth ordinance. We have ended the debate on no-growth. No-growth is something that we just can't have in the United States of America, or we can't survive. For example, if you have a municipal garbage service, and your truck breaks down, you're going to be upset if nobody collects the garbage. If that truck cost your community $22,000, and you go out and replace the truck today, it's going to cost you somewhere around $65,000. Just the inflationary cost of government is almost out of control. It's a very difficult thing for local government or regional government to implement the kinds of regulations that are being mandated by EPA and other agencies, because we don't have any way to finance those, and all of sudden builders' organizations are finding themselves standing up with local government officials saying, "Well, if you want us to do this you will have to show us how to finance it."

I want to ask you, in consideration of regulations regarding erosion and sediment control, to remember the word "flexibility". Particularly when you get into situations dealing with land, as opposed to an overall zoning matter; flexibility is tremendously important. God didn't make all the land just alike. We have a problem in Florida with flat land that won't drain; you have problem up here along the banks of the river; they have a problem in Denver with the mountains and that sort of terrain, and for these differences the ordinances need to be flexible.

Even in your own communities you will find different types of land. Even within one of my own projects I find different kinds of land. You need to think about using your abilities, as people interested in this particular function, to make the ordinances as flexible as possible, so we can build on the areas that are best to build on, and to preserve the areas that are most environmentally dangerous.

In Gainesville, as in other parts of the country, our local governments and our builders' organizations and developers have begun to work together to see what we can do to make things more cost-effective. That's the other word I want you to think about. Who is ultimately going to pay to protect our soil and our natural resources? It's all you folks in the room, it's me, but primarily it's Old Joe Sixpack, the consumer that catches the bill for everything. As Mr. Bauer indicated, there's no way the farmer can afford to recoup out of his market, the vast amount of dollars that it takes to take care of erosion in his business. It's getting to the same point in the homebuilding business. If we're going to protect Joe Sixpack, we're going to have to get together as a country, and shoulder this burden totally.

I want to talk to you just a minute about the components of land development. When my daddy first started building subdivisions in 1927, he built the typical old grid type subdivision, because that's all they knew back in those days. It didn't make any difference if there was a great stand of virgin pine trees or magnolias right in the middle, if the site plan called for the road to go through there, that's where we put the road. It was governed by inflexible zoning, subdivision regulations, setbacks and road design.

We're having a big debate between EPA and HUD right now, two massive agencies of the federal government. HUD tells me on one telephone extension that I have to have 28-foot wide back-to-back curb and gutter, concrete and asphalt, straight-line paving, in my subdivision if I'm going to get it approved for FHA or VA financing. The EPA is telling me that I've got to try to do everything I can to comply with the spirit and mandate of the 208 water management plan, and that means that if you don't need a 28-foot back-to-back street through your subdivision, if you don't need to collect all the water into one great big pipe, and shoot it out where it goes forever and tears up anything at the end of the pipe, then we need to look at some innovative techniques, like open swales and more green areas. And particularly in site-plan development, we need to consider cluster houses. I know for a lot of folks, cluster housing may mean raising the density, but we're going to find as they are finding already in California, that when we run out of land, as they have in some of the European countries, then we will start realizing that we have to take a reassessment of our land planning and our density. So we need to get as much flexibility into the plans as possible.

I'm asking you to allow the development team to do some sort of innovation. I'm asking the people who are responsible for implementing sedimentation and erosion ordinances around the country in local governments, to try to do as much innovation as possible, and to make some cost analysis.

I want to tell you that we've got to change some of our philosophies. The last little area that I developed in Gainesville, Florida, was almost downtown. It's what they call in the industry a bypassed site. It had been there for 25 years, a platted subdivision of one-acre lots, very prestigious, owned by an old family in the community. It was a beautiful piece of land, with a creek running all the way around it, and a lot of virgin magnolias. There's not much elevation change in Florida, but in my particular project you can stand out on the deck or one of my patio homes, townhomes, and 75 feet below you is one of the most beautiful little creeks you ever saw in your life.

I went to our local government and I asked them if we could develop that site, and they said, "Well, if you want to build large houses on large lots you can develop it".

We didn't have a cluster ordinance, so we spent a year and a half and we got one in Gainesville. This was the first project. This was the first time we'd ever gotten government to go down and say, "OK, here's the problem, let's try to find a way to solve it," instead of trying to figure out two or three ways to keep from getting the job done. It has the reputation of being one of the finest projects in Florida, and is completely sold out.

But we had to spend a lot of money to protect that site. I don't think we had a trash can full of sand wash into the creek, while we were developing that project. We took great pains to develop it. Now in the preliminary plans, they called for sedimentation ponds at the bottom of the hill, right next to the creek. In order to get my plan approved, that's what I was required to do. Well, I took a big gamble, and said, "OK, but I want to come back to you and talk to you later on about it." Most of you know that when you put a bulldozer on a slope bank, there just is not any way to protect the vegetation and the things that nature has put there to take care of soil erosion in the original state of the land. And they wanted us to go down there and put these sediment basins in the bottom.

We developed the project in stages. When you're talking to developers, if they have a sensitive area, they need to consider developing in stages, to expose as little of it as possible at one time. If developers are involved in the beginning, most of them will listen, because they are beginning to understand that they've got to listen.

I want to summarize for you.

The number one point that I made was, it's not going to do a lot of good just to regulate somebody that's responsible for less than a tenth of one percent of the soil erosion problem that we have in this country. Actually, 50% of the construction erosion is by public construction, and we don't have any way of controlling that in the NAHB.

We want to have a flexible approach.

We want you to try to include some performance standards in your ordinances. Remember that word, "performance" standards. Instead of going out there and saying, "Boys, this is the way you've got to do it," you need to set out what the goals are that you're trying to accomplish, and let his development team come down with you and you all try to figure out two or three real good ways to solve the problems, as opposed to giving them an actual thing that they have to do.

We want to take a hard objective look at economics, and who is going to pay the bills. Don't forget Old Joe Sixpack. He's the guy that winds up paying the bills for almost all of this, and he's paying just about all he can pay right now, between his mortgage payments and his utility bill, he can't afford much more if the price of food goes up any higher.

I want you to resist the pressure -- and you'll get lot of it in some of your areas, -- to use erosion and sediment control ordinances to be a growth control tool. That's not what you're here for. You're here to try to protect our natural resources. Growth control is not the ultimate objective. Protecting erosion of our soil is the ultimate goal. When you get the pressure groups coming in and talking to you, saying "Uh-huh, we've got this new way we can stop growth," think about that new $65,000 garbage truck you all may have to buy in your community, or think about your own budget in your department, and how you are going to get those increases you need next year.

I want you to try to reduce the processing time, not only in this set of ordinances, but I want you to reduce them in any other ordinances that you can think of, because we have come to the point in time when we need to get together and start working toward being able to provide things that people can afford. Unnecessary delays are a tremendous burden on the consumer ultimately.

I want to let you know that NAHB is really involved in what we are talking about here today. At the Clean Water Task Force, that was organized back in April, I talked with the Assistant Administrator for Water and Wastewater Management. He was one of the most receptive people I've ever met in Government, and I was really overwhelmed. He wrote a letter to all of his regional administrators, back in August 1979, and I just want to read you one sentence: "We would like to see the involvement of the NAHB in EPA activities, develop into a useful partnership aimed toward melding protection of the environment with home building." That's our goal now. Our methodology is, we're going to set up regional watchdog liaison committees with the EPA in the ten regions of the United States. I've already set up two of the regions, Region 4 which is Atlanta, and Region 1 which is Boston.

We will hire a permanent consultant in each region, and he is going to work on a daily and weekly basis as liaison with the EPA, having primarily to do with the Clean Water Act, but ultimately, whenever the NAHB addresses environmental issues from now on, we're going to address them nationally instead of this piecemeal effort that we have done before which has been such a miserable failure. The apparatus is going to be our regional committees.

We've had a lot of participation already in these different regions, and it's been a very warm experience. The two Regional Administrators I've met with, tremendously welcomed our participation. The Federal Government has mandated that government agencies need to get out into the private sector and get some participation. I think they finally realized that a great deal of the voluntary participation they were getting was different little public interest groups, and none of them represented private business or free enterprise or the people who are trying to make the money to pay the taxes. We're going to try to help fulfill that role. We'll fulfill it for any local, state or regional governmental agency that needs some participation from the private sector. All you've got to do is get in touch with me or my staff, and we'll make sure somebody participates from our industry.

We have a challenge and an opportunity ahead of us. This is a time when we need to get participation from all different points of view. The danger is that if we aren't careful, we may be cutting off the people who can most afford to pay the bill for the major problems that we have in erosion. If we cut down our tax base any more, or if we stop growth altogether, and we can't raise the funds, then there isn't going to be any money to be sent down through these programs to help take care of erosion and control sediment.

EXTRACT FROM QUESTION-AND-ANSWER SESSION

Q: Regarding your development in Gainesville. If you had not been made aware of the situation in regards to erosion and sediment control, would you in fact have initiated a program to protect that site to the degree that you did, had you not been acquainted with it through some regulatory agency? Secondly, you mentioned that it was necessary that the private sector get involved in the formulation of performance standards or regulations. Why haven't they done it before? I happen to agree with you, but I'm wondering why they haven't done it before. They always come up after the regulations have been adopted, and haven't taken any part in the adoption proceedings whatsoever. It seems a very good idea that they get involved in the beginning. How would you suggest that we get that local involvement from those local building associations? We can't go from my county to Washington D.C. and ask the National Association to come out and help us solve an erosion control ordinance. How do we get them motivated?

A: KIRKPATRICK: We're all growing up in our attempt to develop land. I Think you'll find that the present-day developer understands that to destroy the enviornment is to destroy a good proportion of the real sales value of the project. At the price that we're having to charge for houses, 48 or 50 dollars a square foot, what we're selling is perceived value. People don't want to live in grid-type subdivisions where they clear-cut everything and start all over. I think our industry is beginning to grow up and understand that that's not the way to do things.

As far as getting people involved, I think you can go to the National Association of Home Builders. If you're willing to place a telephone call to our association in Washington, or to our individual state associations, and speak with the executive director, I know that you will get a response. We've got to quit protecting our own little turf, and end the polarization, and start working together on these things. I know that I can find somebody to sit down with you, regardless of what community you're in, and participate from the very beginning. The purpose of this conference is to try to develop some local soil erosion and sediment control ordinances, to trade ideas, so this is the beginning of a lot of the soil and sediment control ordinances for a lot of localities. This is where we begin, right here. I'm here participating. I'm not any heavyweight technician, but I'm here as representative of a large association that wants to help out. I know that if you would like to have participation with our industry, I'll make arrangements if you can't find anybody else who can. Remember there are 700 local associations, there's a state association in every state, and if you can't get one of those, I've got some folks in Washington who will do it.

THE ROLE OF REGULATION IN URBAN EROSION AND SEDIMENT CONTROL

Frank Beal, Director
Illinois Institute of Natural Resources

A decade ago, I learned a little memory trick to remind me of the powers of government. It turns out that the letters of the word ACID stand for the four things that government can do for or to its citizens.

The letter A stands for advice, and we all know governments have plenty of that. The letter C stands for control, wherein governments use their police power authority to compel certain actions or to prohibit action. The letter I stands for incentives, such as the federal income tax incentives that encourage home ownership, or the proposed price guarantees for the purchase of synthetic fuels. Finally, the letter D stands for direct action. Examples here include the highway built by government or the patient cared for by the authorities in a state mental hospital.

There was a time, no doubt, when most public problems could be addressed by using one of these four public policy devices: advice, regulation, economic incentives or disincentives and direct action. For the most part, those simpler days are gone, and the interesting public problems are generally addressed through a rather complex set of governmental actions. I would remind you, therefore, that although my remarks this afternoon are limited to the role of regulation in urban erosion and sediment control, we must not lose sight of the other powers of government that can and must be turned toward this exceedingly complicated issue.

Let me simply say at the outset that regulation can, does, and should play a central role in urban erosion and sediment control. I say this in full knowledge and awareness of the cries for deregulation in all sectors of our public life, and in recognition of the growing pressures to slow down the environmental movement.

I happen to think that many of the pressures for deregulation are well founded. Many of the federal regulatory systems, for example, were set up to deal with circumstances and problems which no longer exist, but bureaucratic momentum has relentlessly carried them forward. Bureaucratic zeal is the culprit in many cases. It is sad, for example, to see the very laudable goals of the Occupational Health and Safety Administration get confused with OSHA's efforts to regulate the size and shape of toilet seats.

The bureaucracy is not always to blame. We must place a lot of responsibility with the Congress and its inability to be clear about national objectives. Furthermore, the regulated industries themselves must share part of the responsibility. In far too many cases they oppose deregulation, knowing that any move in that direction might well allow more competitors into their protected share of the market.

You are all, I am sure, painfully aware of the growing number and intensity of attacks on environmental regulation. I cannot think of an agency of the federal government as abused as the Environmental Protection Agency. This has not always been the case, and I think the reasons for the shift in attitude merit some examination, since it relates to the question of the role of regulation in urban sediment control.

By way of background, I must remind you that there is a whole generation out there who believe that a concern for the environment began with Earth Day. It didn't. Such a short-sighted view ignores the contributions of a man like Teddy Roosevelt who, in the early 1900s, did so much to protect this nation's wilderness resources. It ignores a man like Hugh Bennett who shaped the soil and water conservation movement of the 1930s. The truth, of course, is that this nation has always had an underlying concern for the protection of its environment, even if that concern was overshadowed frequently by the resource exploitation that accompanied western expansion.

What happened after Earth Day was that the environmental and conservation movement was essentially co-opted by the federal and fifty state environmental protection agencies. In response to the pressing problems of the day and the demand for quick action, these agencies became the glamour agencies of government, charging off to prosecute everything in sight.

I will be the first to admit that the work of these agencies was of immense importance to this nation. One need only recall a Pittsburgh that was almost uninhabitable and a river in Cleveland that was burning to see how far we have come. We have paid a price for this progress, including the price of a citizenry who believes environmental management means pollution control, and who believes that the way to solve an environmental problem is to go out and find the bad guy and regulate him. That works sometimes, but not always.

Another price that we paid is that the glamour of the EPA overshadowed some of the fine ongoing work of the Departments of Agriculture; Interior; and Health, Education and Welfare, to name only three.

The decade of the 1980s promises to be one in which the public learns, or relearns, that there is more to ecology than prosecuting polluters, and that the stewardship of the nation's resources belongs to more than one agency of government and employs more tools than simple regulation. The environmental protection agencies of this country have hit the easy targets. They are now facing the more complex problems, such as urban erosion, and they are looking for help from other agencies of government.

I do not want to stray too far from my assigned topic, but I thought it was important to set the stage for the more detailed discussions you will be having for the next two days. I know you will be spending a lot of time examining specific regulatory systems designed to control urban erosion and sediment control, but I would like to make a couple of general points that

I hope will carry over into your later discussions.

When reading about erosion and runoff, what strikes me is not our lack of information about its cause and remedies, but how little we do about it. The Soil Conservation Service has been promoting contour plowing, crop rotation, and minimum tillage for years, but it is still news when Iowa or Minnesota succeed in getting some proportion of their farmers to use these tehcniques. Likewise, we know that protecting natural drainage systems in subdivisions can substantially decrease runoff problems and save tremendous amounts of money that would need to be spent on stormwater drainage systems. But again, it is news when a community is designed on these principles.

The critical problems in controlling erosion and runoff are not scientific, technical or legal; instead, they come from the professions of land use. Land development - whether it is urban construction or agricultural use - is a craft, not a science. Except in rare situations, the methods used by developers and contractors represent an accumulation of experience. Some of the methods may be learned from the professional journals or from the classroom, but most come from on-the-job training. They are learned in apprenticeships, by observing successful developers, and by discovering for oneself what pays off. The same is often true for farmers.

Realizing that these professions are crafts tells us that change will be incremental and evolutionary, but it does not tell us why it has been so slow. Why have they been so slow to recognize the pearls of research we have thrown at their feet? As a class, I do not find farmers stubborn or stupid; rather, I find them wiley and crafty. Clearly the problem is not an information gap. It is a gap between the long-term public interest in protecting our resources, and the short-term pay off of building developments or selling crops. One lesson learned in the evolution of development and farming is that many of the consequences of erosion and runoff are not felt by the landowner. The serious costs are paid by other landowners or society at large - not by the individual.

We must find methods of internalizing considerations of erosion and runoff so that the development and agriculture crafts will start taking these factors into consideration. I believe that one effective method of accomplishing this is through land-use regulations. However, since our goal is to change the character of the land-development crafts, they cannot be our typical ten-commandment regulations (thou shalt not build subdivisions on prime agricultural land). Instead, they must be designed so that the natural evolutionary and experiental processes of these crafts work.

This may sound complicated, but in actuality it is quite simple. A review of some recent ordinace provisions provide excellent models of how these regulations should be designed.[1]

One of the first agencies to promote regulations for urban runoff was the Metropolitan Sanitary District of Greater Chicago. With its broad powers in the issuance of sewer permits for new construction, the board moved to include consideration of runoff into the issuance of sewer permits. As adopted by the board, the Sewer Permit Ordinance stated that: "Effective January 1, 1973, no permits shall be issued for sewer construction in unsewered or separate sewered areas when construction of the facilities to be served by the proposed sewer would result in runoff in excess of that from its natural or undeveloped state..." The objectives of these regulations are to maintain the integrity of the natural drainage patterns of the area in order to prevent flooding and drastic alteration in stream channels. As they note, "The channel configuration cut by nature is generally unable to handle the runoff from high-intensity rainfalls and results in floodplain storage or spreading of the runoff over the land." To stabilize the runoff from such areas after the development, the sanitary district requires that the release rate be limited to the carrying capacity of the natural channels.

The regulation mandates minimum performance standards for both the rate and the volume of runoff, which local governments have to implement. For the rate of runoff the ordinance states: "The release rate of storm water from all developments requiring detention shall not exceed the storm water runoff rate from the area in its natural state." For considerations of volume, the district requires detention storage which operates in conjunction with the standards for the rate of runoff: "The live detention storage to be provided will be calculated on the basis of the 100-year frequency rainfall as published by the U.S. Weather Bureau for this area. The detention volume required will be that necessary to handle the runoff of a 100-year rainfall, for any and all durations, from the fully developed drainage area tributary to the reservoir, less that volume discharged during the same duration at the approved release rate." Even under the worst meteorological conditions, the land area is to function as it would under natural, predevelopment conditions.

The results of this metropolitan-wide regulation was the adoption by local agencies of runoff controls based on these minimum guidelines. While the district sets the minimums, the local communities are free to stiffen the required level of performance.

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[1] The following discussion is based on work done by Charles Thurow, William Toner and Duncan Erley. Performance Controls for Sensitive Lands (ASPO): Chicago, 1976. In addition, I would like to express my gratitude to Charles Thurow for allowing me to use material originally developed by him in a 1978 speech entitled, "Regulating the Flow of Water to the Sea."

In accordance with the District requirements, Naperville, Illinois adopted an ordinance to control runoff. The purpose of the ordinance is "to eliminate the storage or transportation of excess storm water in or through habitable structures." The ordinance covers all commercial and industrial developments and all residential developments of more than two and one-half acres.

The performance standard for runoff is directly tied to the capacity of the watershed drainage system: "The controlled release rate of storm water runoff from all developments...shall not exceed the existing 'safe' storm drainage capacity of the natural downstream outlet channel or storm sewer system. The release rate shall be an average value computed as a direct ratio of the tributary watershed area. This value shall not exceed an average runoff rate of 0.15 inches per hour which is compatible with the 'safe' capacity of the West Branch of the Du Page River and the Des Plaines River. The rate of which storm water runoff is delivered to a designated storm water storage area shall be unrestricted," Standards were also established for the control of the volume of runoff: "Required volume for storm water detention shall be calculated on the basis of the runoff from a 100-year frequency rainfall of any duration as published by a recognized agency. This volume of storage shall be provided for the fully developed watershed that is tributary to the area designated for detention purposes. The storm water release rate shall be considered when calculating the storm water storage capacity and the control structure designed to maintain a relatively uniform flow rate regardless of the depth of storm water in the storage area."

A slightly different approach has been taken by DeKalb County, Georgia. Within a general environmental ordinance, they set up specific regulations concerning storm water retention and drainage. Instead of specifying the kind of development or the size of development covered by the ordinance, they set a standard of what they considered the critical breaking point for regulation: "A combination of storage and controlled release of storm water runoff shall be required for all development and construction which will increase the peak rate of runoff from the site by more than one cubic foot per second for a 10-year frequency storm." The ordinance then goes on to set the performance standard for the rate of runoff: "The peak release rate of storm water from all developments where retention is required shall...not exceed the peak storm water runoff from the area in its natural undeveloped state for all intensities up to and including the 100-year frequency and all durations of rainfall; or...not to be greater than that calculated for a storm of two-year frequency with a runoff coefficient of 0.20, 0.25, and 0.35 for land with an average slope of up to two per cent, two to seven per cent, and over seven per cent, respectively."

Through this mechanism they have set a minimum requirement for all development and added more stringent requirements for developments on slopes. Finally, the ordinance sets the performance standard for the control of the volume of runoff. "The live retention storage to be provided shall be calculated on the basis of the 100-year frequency rainfall as published by the National Weather Service for the affected area. The retention volume required shall be that necessary to handle the runoff of a 100-year rainfall for any and all durations from the proposed development, less that volume discharged during the same duration at the approved release rate as specified above."

Regulations such as these often do not meet with the approval of soil scientists or engineers. Standards that use such language as "its natural or undeveloped state," or "maintain the integrity of the natural drainage patterns" seem particularly fluffy. What is the definition of "natural state?" What the hell do you mean by "integrity?" The standards that use numerical figures equally raise questions: How did they come up with those figures? What is magical about 60% impervious surface?

These questions miss the point on two accounts. First, regulation is yet another craft. Public administrators work in a world that constantly requires them to interpret such items as "significant impact" or "undue harm." For such problems as erosion and runoff, it is particularly impossible to write specifications that are going to work with every parcel of land. Instead, local staff must be able to look at a piece of property and recognize what the serious problems will be, to judge the proposed methods of controlling erosion and runoff and finally, to interact or negotiate so that both the person using the land and the general society benefits. This craft is also developed through experience. It is only through successive reviews of site plans and subsequently watching their effect on the problems of erosion and runoff that a community will develop the ability to significantly tackle these problems.

Second, it is necessary to remember that land-use regulations are the embodiment of social policy. And in terms of governmental policies, these statements are more precise than most. These communities are saying that the cost of increased runoff is to be born by the development itself and the control of runoff is to be done at the site itself.

Of course other communities have made other policies. For example, Chicago itself has decided that it is best for society generally to handle some of the problem with their current deep-tunnel project (at the cost of 7 billion dollars). DeKalb County, in practice, has developed a hybrid of these two policies. With their runoff ordinance, the county still plans to construct storm water retention facilities itself, as a service to landowners. If the developer does not wish to build his own facilities, he can use those constructed by the community, but he is assessed on the basis of the runoff he contributes to the drainage system. Arvada, and Boulder, Colorado have used similar assessment provisions. These communities are saying that if retention facilities must be built, it is best that they be constructed and maintained by the government. But still we want to give incentives to the developer to minimize runoff.

The importance of these regulations goes back to my earlier point about development and construction as a craft. By setting these public standards or goals, the developer is free to figure out how to respond on his own. He is not required to put in a specific size storm drainage system or use retention ponds. He is allowed to experiment with different methods and techniques; and the system encourages the trade to find the most cost/effective method of controlling runoff. In Naperville, where the development community initially opposed the adoption of the regulations, they found that developers were able to reduce development costs by using different techniques than the previously required storm sewers.

In practice, the standards must be judged in terms of their clarity to the individuals who must comply and to the public officials who must enforce - not their scientific merit. The concept of "natural condition" may be more accessible than runoff coefficients or mathematical models for computing the amount of water leaving a site.

There is a great risk that you will get caught up in arguments that we do not know enough or that we need more research before we can impose regulations. I say that is nonsense. We do know enough, and there has already been enough experience to tell us that local regulations work.

There are regulations which set standards and there are those which specify management or operating practices. I personally prefer the standard setting approach since it plays to the strength of the craft systems. It encourages experimentation and innovation. By setting out particular practices that must be followed, there is a risk that they will become institutionalized, and the developer's ability to be creative will be lost.

Whatever approach is used, the agency regulating urban runoff and erosion will have to be close to the site. We will have to rely on our local governments to build their administrative ability to handle such regulation. (I do not think they have it now.) However, it is necessary for the first steps to be taken by state governments. Often, the erosion and runoff problems are not any more critical to the local government than they are to the individual landowner. It may be the town down the river that gets the flood water, or the harbor many miles away that gets the silt. But more important, state mandates provide political clout that is almost universally lacking with local jurisdiction. From my discussion with local planners, it is not that they are unaware of these problems or unwilling to tackle them, but that they have no base from which to work. It is not that they need great guidance from the state, it is simply they need the state to be backing them up.

The problems of urban runoff and erosion are yet to be solved. It is clear that the process will be slow. It will be a process of getting the states to make the necessary commitments, convincing local governments to pass the regulations, and then developing the administrative skills to implement them. It will not be easy, but it will be worth the effort.

URBAN EROSION

Gerald Willet
Minnesota State Senator
Chairman,
Agriculture and Natural Resources Committee

Although we Minnesotans, living in the land of more than 15,000 lakes and 25,000 miles of streams and rivers, generally take our water resources for granted, the fact remains that our ground and surface waters are far from limitless.

Therefore, we would do well to apprise ourselves of, and respond to, the potential threat to those resources. The most publicized threat has been, of course, pollution.

In southeastern Minnesota, for example, we have seen a growing concern over the impact of such polluting occurrences as waste spills and fractured limestone on groundwater--The primary drinking water source for two-thirds of our state residents.

We have also seen concern over the pollution of Lake Superior; witness the Reserve Mining suit. And, recently, more than $200,000 was spent to rid Twin Cities' area waters of contaminating Algae--which thrive on the cleaning compound phosphates which find their way into the metro area waste water system.

These, of course, are all unique and readily recognizable threats to our water resources. As such, they have become the focal point of considerable public attention. The most common water resource pollutant --sediment, resulting from erosion, however, seems less dramatic and has received little public attention. As a result, our ability to deal with sediment--as a water pollutant--has failed to keep pace with the impact of natural and man-caused erosion on our surface water.

Nationally, sediment is the highest volume water pollutant known to man, with some five billion tons of damaging sediment reaching U.S. surface waters annually.

Surprisingly, only about 30 percent of that sediment is due to natural erosion, with the remaining 70 percent the result of such human activity as forestry, mining and residential and commercial and industrial construction.

Construction is rather unique in its damaging contribution to polluting sediments. While construction contributes ten percent of the total sediment tonnage, it affects only seven hundredths of one percent of total land resources. That provides a solid indication that construction erosion is heavily concentrated and, therefore, potentially more damaging than equal doses of other types of sediment.

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Construction sediment also carries a variety of potentially-damaging pollutants. Pesticides, gas, oil, asphalt, metals, roofing materials, acids, concrete curing compounds, garbage, lime and various fertilizers all represent materials included in construction-related sediment which pose a serious threat to our surface waters.

And, since this is a conference on urban erosion control, I should also point out that the heaviest concentration of construction sediment finds its way into waters passing through urban areas--where, naturally, one finds the heaviest construction activity.

In the Twin Cities alone, a recent survey showed some 140,000 tons of soil lost due to construction activity in a single year, with 55,000 tons of surface water sediment produced as a result of that activity.

And, private construction is not the only culprit in sediment production. Road, street, and highway construction produces similar problems and highway design can result in increased erosion.

That erosion, which usually takes places on a backslope or in a ditch, contributes to the loss of 100,000 tons of soil annually; soil which finds its way into our surface water--and which may carry a variety of roadside wastes and pollutants.

Another form of erosion, common to urban areas, and which contributes greatly to water pollution, is streambank or channel erosion.

Streambank and channel erosion in the metro area alone, contributes close to 600,000 tons of sediment to Minnesota waterways each year.

There are a variety of factors behind that erosion including natural causes such as the deepening or widening of the channel due to water passage; an increase in peak runoffs; poorly-controlled storm discharges; urban development on streambanks; and the use of those banks for recreational purposes.

Obviously, soil erosion poses a threat to our waterways, and the additional and uniquely "urban" chemicals and waste included in stormwater runoff or erosion resulting from urban development along the streambanks amplify that threat.

These, then, are the main sources of surface water pollution which fall under the title of "Urban Erosion". Coincidentally, they are also among the most common and most neglected sources of overall water pollution.

And, just how have we been handling the problem of urban erosion--of an increasing volume of sediment in our vital waters? Not very well. As a matter of fact, the regulation of urban erosion has been extremely fragmented and, at times, about as effective as shoveling snow with a pitchfork.

Erosion control at construction sites, for example, is exercised by a variety of federal, state and local departments, agencies and governmental units.

Most often, that control falls under the authority of a local governmental unit and is carried out through municipal or county ordinances.

The guidelines followed, the standards set and the efficiency of enforcement, of course, vary from local unit to local unit--and there is little continuity in our approach to the erosion problem through local control. That does create some problems, when you consider that unchecked erosion at one point in the waterstream can adversely impact water quality further down that waterway.

The problems inherent in our current uncoordinated system of erosion control become further amplified when one considers that the authority of local governmental units sometimes overlaps that of watershed districts--and that local units of government may also exert considerable influence over streambank erosion through shoreland management programs.

Another potential source of control on major projects is exercised by the Environmental Quality Board, which may require an environmental impact statement on projects of more than local significance.

Erosion control authority related to highway construction is also fragmented, with projects using federal or state aids subject to federally-approved Minnesota Department of Transportation Erosion Control Guidelines.

Projects where counties, municipalities or townships use their own funds, however, are subject only to local standards.

And, to further complicate matters, certain projects--most often bridges--termed "In the Bed of Waters" fall under the auspices of the Department of Natural Resources Erosion Control Guidelines.

In short, we have created a maze of erosion control procedures which often leave the communities and agencies involved somewhat confused as to who has the ultimate authority over individual projects.

In addition, by establishing no solid state guidelines, we have also left the extent, enforcement and quality of erosion control efforts solely up to the involved units--most often local governmental bodies.

This voluntary program of local control has not proven as effective as we might have hoped. A recent survey, for example, showed that 54 percent of our metropolitan area municipalities do not have erosion and sediment control ordinances on the books, and a similar number do not have a comprehensive stormwater control plan.

In addition, the fact that counties, municipalities, the E.Q.B., DNR, MN DOT and local watershed districts share authority for erosion and sediment control has, at times, caused some confusion--confusion that has resulted in a delay in the development of much-needed local or state regulation.

Local authorities have also found it difficult, at times, to enforce ordinances which could delay development activity which has the support of the general population--despite its potential impact on nearby surface waters. We must remember that, in most cases, that development also has the potential to expand the local tax base.

This situation seems to call for a change in our approach to erosion control--a change which would move us toward more centralized administration of the erosion control programs.

Legislation has been introduced which would accomplish that goal--calling for the development of a set of state guidelines, by the Soil and Water Conservation Board, which would be used by local Soil and Water Districts to formulate specific local erosion and sediment control regulations.

That system has the advantage of ensuring consistent standards for erosion control on a statewide basis (through the Board Guidelines), while still allowing local Soil and Water Conservation Districts considerable flexibility in developing specific rules and regulations.

I should point out that the proposed new system would not create any additional bureaucracy, as our soil and water conservation districts are already operating as resource management agencies in other areas. And, I might add that several states have already adopted this mandatory erosion and sediment control system--with local conservation districts as the principal administrators with a great deal of success.

There is, of course, a great deal of support for solely local control. And, while I do support minimal state intervention in local activity, the fact remains that one area's erosion control efforts can have a significant impact on neighboring communities. That fact, in itself, seems to mandate a coordinated effort, with specific quality guidelines.

As the legislation aimed toward improved and coordinated erosion control develops, I also intend to work to ensure that any plan includes significant local and public input into the actual rules and regulations. I feel it is imperative that each local government involved be guaranteed a strong voice in the development of any regulations which would affect that community.

I should also add that any new regulations which would require landowners to install erosion and sediment control structures--retroactively upgrading their erosion control efforts--should be accompanied by a system of federal or state financial aids to meet those costs. Those aids could be provided in a variety of ways ranging from low interest loams--to grants--to tax credits, but they do seem a necessary part of any new activity which requires "retrofitting" in relation to erosion and sediment control.

I did note that the bill already introduced stipulates that no landowner shall be required to install new wind, water or gully erosion control structures "unless state, federal or local public cost-sharing funds have been specifically approved for such land and actually made available to the land occupiers in an amount equal to at least 75 percent of the cost of any permanent conservation practice."

That clause would apply to both public and private lands on which improved erosion control was being retroactively enforced. Although that protection may not answer all the problems faced in applying any new regulations, it does provide an important protection for landowners and local units of government--and would allow additional time to develop other aid systems, if necessary.

The bill now under consideration also calls for the establishment of meaningful limits on soil erosion levels, as well as provide for a workable inspection and enforcement system.

Here again, however, I would be cautious about the approval of those portions of the proposed new system without ensuring adequate input from the local landowners and governmental units involved.

In short, we must ensure adequate public hearings on the concept of a more centralized erosion and sediment control system.

Those hearings would also allow us to overcome some of the opposition to the proposal, most of which is based on a feared loss of local control and initiative.

While that fear is genuine and must be addressed, we should point out that any legislation approved will include provisions for local input; and that the Soil and Water Conservation Board Guidelines are intended to be flexible enough to allow the tailoring of local regulations to meet local needs--while maintaining a consistent statewide erosion control standard.

Public hearings on the proposal also would provide us with a vital opportunity to impress the severity of the problem on the general public. While the potential threat of nuclear wastes, the expansion of the sanitary landfill system and visible air pollution are easily impressed upon the general public, the threat posed by urban erosion is somewhat less visible and has not caught the public's attention.

Therefore, as I look to the legislative future of urban erosion and sediment control, I see an increased effort first to educate the public as to the need to address this problem and, second, to develop a system of state guidelines for erosion and sediment control which can be incorporated into local regulations.

Vital to any such effort, of course, will be ensuring adequate local input into the specific rules and regulations--since local citizens and public officials have the greatest knowledge of local difficulties and needs.

At this point in time, the development of general guidelines by the Soil and Water Conservation Board, coupled with more specific regulatory action by Soil and Water Conservation Districts seems the most viable approach to the problem.

It is also an approach I feel will be supported by landowners and local governments across-the-state, if we take the time to present it properly, listen to public concerns and needs and act in a manner responsive to those local concerns.

I truly feel that our overall need for improved erosion and sediment control is compatible with the needs of local landowners and communities, and that we can work together to reduce the threat urban erosion poses to our waterways.

PRESENT URBAN EROSION CONTROL TECHNIQUES

Richard E. Highfill, P.E.
Agricultural Engineer, Engineering Division
Soil Conservation Service, USDA, Washington, D.C.

Abstract: Research has shown substantial increases in stormwater runoff, erosion, and sediment yield from untreated construction sites when compared to previous conditions. These increases can be reduced to tolerable levels by planning and carrying out an effective erosion control program. Developed areas include a large proportion of impervious surfaces such as parking lots and rooftops, which produce more runoff at higher rates unless a runoff management system is planned and installed concurrently with the development.

Planning techniques, sequencing, and erosion control practices can reduce erosion substantially. Sediment basins can be used to reduce sediment yield downstream. Runoff management systems can be used to keep the rate of runoff the same as it was before development. The paper describes planning techniques, conservation practices for erosion control, sediment trapping practices, and runoff management systems including their use and effectiveness (Highfill and Kimberlin 1977).

INTRODUCTION

Erosion in urban areas amounts to 130 to 170 million tons of sediment each year. Although this seems minor compared to cropland erosion, urban erosion creates numerous other problems...leads to flooding and sedimentation...damage to structures...impairment of water quality.

It is easier to solve the problem by building a solution into construction designs rather than waiting for the damaging effects caused by construction that doesn't consider erosion potential and excess runoff. Erosion control in urban areas applies to (1) areas under construction; that is, erosion directly caused by construction activities; (2) planning how to build in solutions that will be presented by a development... (3) installing erosion and runoff controls in developed areas where such controls had not been provided during construction.

PLANNING

There are several guidelines that should be considered in developing plans for erosion and sediment control and runoff management (Boysen 1977). They are:

1. Study and analyze flood hazard maps, soil survey reports, geology reports, and other appropriate resource information and plan to overcome limitations of the site.

2. Plan the location of structures and roads to provide for gentle slopes, retaining the existing vegetation, as little earthmoving as possible, and leaving the topography and soils in a condition that presents a minimal erosion hazard.

3. Schedule construction activities so that the smallest area of land is exposed at any one time, the most hazardous area is exposed when extreme rainfall is least likely to occur, and revegetation can take place at the most advantageous time of year (Wischmeier and Smith 1978).

4. Plan to use temporary measures to reduce erosion. Preventing erosion has many advantages over preparing means to trap sediment.

5. Plan for effective control of foot and vehicular traffic during and after development.

6. Install permanent structures and final vegetative measures as soon as practical during the development.

7. Plan the use of sediment basins to remove sediment from runoff water. Provide maintenance instructions.

8. Plan for effective water disposal including runoff management systems, subsurface drainage, and permanent water bodies for recreation and wildlife.

9. Plan for visual resource enhancement.

Technical assistance for planning is available from local soil and water conservation districts. Many states in cooperation with the Soil Conservation Service (SCS) have developed excellent guides for controlling erosion and sedimentation in areas planned for urban development. One of the popular ones is "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas," prepared by SCS in 1975 for the Maryland, Water Resources Administration (US EPA 1973, SCS 1975a).

SCS can provide technical materials and, in some cases, assist in training sessions (SCS 1977). Conservation districts, consulting engineers groups, state agencies, and SCS have organized and held many training sessions for those involved in planning and installing practices and enforcing sediment control regulations.

EROSION CONTROL PRACTICES

Planning the proper location of access roads is an important part of any erosion control system. Roads should be planned along with other conservation practices to provide a good route for travel and for moving equipment and supplies and to allow access for construction, operation, and maintenance of structures and conservation practices. Culverts should be planned and installed early to provide good drainage without polluting runoff water.

Vegetation is the first line of defense against erosion (SCS 1970, SCS 1979). Temporary vegetation can be used where protection is needed during delays in construction activities or until conditions are right for permanent vegetation. Locally adapted species and establishment procedures should be used. Permanent vegetation should be established as soon as final grading is complete. Species should be selected to fit soil conditions, climate, land use, mowing anticipated, and nutrient maintenance. Soil amendments should be included and provisions made for additional nutrients to insure a successful stand. Mulches can be used where necessary to secure a stand of vegetation and to provide stability until the vegetation is established.

Mulches can be used for temporary erosion control, and in some places mulches of gravel, stone, and cement blocks may be appropriate for permanent protection. Straw, hay, wood chips, bark, shells, hulls, stone, jute mesh, synthetic fabrics and materials, plastic netting, and asphalt products can be used as mulching materials (Chepil 1963, Dept. of Water Res. 1972).

Land grading is an important factor to consider in planning for erosion control during and after development activities. Water disposal, traffic, structures, and stability of cut and fill slopes must be considered in making the grading plan. Topsoil should be stockpiled for later use on graded surfaces. Provisions must be made to conduct surface runoff to the water disposal system without causing erosion damage. Cut and fill slopes must be stabilized to prevent slides and erosion. Maintenance and safety requirements must be considered in setting the grades and slopes. Berms (terraces) can be placed on steep slopes to increase slope stability, intercept surface runoff, and break up long slopes. Diversions can be placed at the top of cut slopes to convey runoff from other areas to stable outlets so that it does not run down cut slopes. A diversion is a channel with a supporting ridge on the lower side.

To reduce the erosion hazard of concentrated runoff water, a spreader can be installed. A spreader is an outlet constructed across a slope to discharge concentrated runoff onto a stable vegetated area where the water spreads out and is less erosive.

Grassed waterways are natural or constructed outlets to dispose of excess surface runoff. A subsurface drain or stone center can be constructed in a waterway to handle long-term low flows to insure effective grass cover.

Lined waterways can be used where vegetation would not be a satisfactory solution. Linings are usually made of concrete, mortared stone, or riprap.

An underground outlet (storm sewer) is a conduit installed beneath the ground surface to collect surface runoff and convey it to a suitable outlet. Inlets should be designed with appropriate trash and animal guards so that any trash entering will go through the conduit without plugging and so that design capacity will be maintained. Inlets must also be vandal and child proof. Outlets must be stable for all anticipated flow conditions.

Grade stabilization structures are used to control the grade or prevent head cutting in natural or artificial channels. Pipe drop inlets, hooded inlets, pipe slope drains, paved chutes or flumes, drop spillways, box inlet drop spillways, drop box to culverts, and toe walls are common types of grade stabilization structures.

Subsurface drains (tile) intercept, collect, and convey drainage water. They are used to improve the soil environment for plant growth by regulating the water table and ground water flow; intercept and prevent water movement into a wet area; relieve artesian pressures; facilitate leaching of saline and alkali soils; remove water from around buildings, roads, airports, play areas, and other developments; and regulate water to control health hazards caused by liver flukes, flies, or mosquitoes. Corrugated plastic, clay, and concrete are commonly used for subsurface drains but perforated asbestos and metal pipe are also suitable. Surface drains or open channels can be used in developed areas where the disposal of large quantities of water is required.

Heavy-use areas can be protected by establishing appropriate vegetation, by surfacing with suitable materials, or installing needed structures. Common protection devices are grasses suitable for heavy traffic; gravel, asphalt, or concrete walkways; gravel protection pads under and around playground equipment, and hard surfacing for occasional parking areas.

SEDIMENT TRAPPING PRACTICES

Sediment transported in water can be removed if the velocity of the water is reduced sufficiently to allow the particles to settle out (ASCE 1975). The largest particles are easiest to get out, but the removal of very fine clays may require months of very still water or chemical treatment. This discussion considers only the use of vegetative filters or sediment basins to remove sediment particles.

In some cases straw bale dikes are used to trap sediment. If installed properly they can help, but most installations I have seen in the field were not installed properly so that very little sediment was trapped. A filter strip is an area of vegetation for removing sediment, organic matter, and other pollutants from surface runoff. For the filter strip to be effective, the flow must be first spread into a thin, wide sheet so that the water goes slowly through the vegetated area instead of running through it rapidly as a concentrated flow. Tests at Purdue have shown that an 8-foot filter strip can trap as much as 80 percent of the fine sediments (<0.002 mm). The same tests indicate that an 8-foot filter strip is adequate to remove most of the fine sediments when the contributing area is no more than 80 feet wide.

Sediment basins are constructed to collect and store waterborne sediment or debris. The basins are designed to store the anticipated volume of sediment while maintaining the required trap efficiency (Holeman 1977). In some cases sediment basins can be cleaned out to restore their effectiveness.

The basin must be shaped so that the inflow is hydraulically far enough from the outlet to allow time for the sediment to settle out. Baffles can be added for this purpose if necessary. Sediment basins are more efficient if they are maintained full of water. If this is not practical for safety and health reasons, the pool should be drained at a very slow rate.

Studies in Maryland have shown the average trapping efficiency of properly designed sediment basins to be more than 90 percent (Davis 1978) for the normal range of expected storms during a development period. Sediment basins can be expected to trap about 85 percent of the incoming sediment if the water storage is approximately 10 percent of the annual runoff from the drainage.

Sediment traps are small sediment basins used to trap sediment from small disturbed areas (usually less than 5 acres) (Boysen 1978). These may be formed by constructing small earth dams or digging a pit. They are usually built in conjunction with small dikes to exclude runoff from undisturbed areas and force all the runoff from the disturbed area through the trap. Some traps have earth outlets, some pipe, and some rock; some are excavated below the invert of stormwater inlets.

RUNOFF MANAGEMENT SYSTEMS

Covering the soil with impervious surfaces such as roofs and paved parking lots increases both the rate and volume of runoff (SCS 1975b). This increase can cause channel erosion in the natural drainageways downstream from the developed area. For this reason, many state and local government agencies have regulations requiring developers to provide floodwater storage to control part of or all of the projected increase. The required reduction in runoff is usually based on a particular storm or from storms of a given frequency.

Runoff management systems (sometimes called stormwater management systems) control excess runoff caused by urban development or by changes in land use (SCS 1977). This is usually done by some type of detention structure or infiltration device. The SCS standard calls for no increase in runoff rate due to the 2- or 100-year frequency, 24-hour storms unless downstream increases are compatible with an overall flood plain management plan.

Components of runoff management systems include such practices as dams, excavated ponds, infiltration trenches, perforated parking lots, parking lot storage, rooftop storage, and underground tanks. These components are described in detail in the SCS standard for runoff management systems (see attachment 1).

In many cases, ponds developed for the runoff management system can be used for recreation or for fish and wildlife habitat. It may be possible, after construction is complete, to convert a sediment basin to a multiple-use pond for stormwater storage and recreation. This can be done more easily if the original design of the basin is based on these final uses. Ponds also add diversity to the landscape and thus improve the visual resources of the area.

One study has shown that the impairment of downstream water quality begins when 10 percent of a watershed is covered by impervious surfaces and becomes severe when the impervious area reaches 30 percent (Klein 1979). Runoff management systems can reduce the decline in stream quality as development takes place.

GENERAL

Several other aspects of urban erosion and sedimentation control are essential:

1. Sediment control must be a policy of government agencies and the necessary ordinances must be enacted and enforced.

2. The public must be made aware of the problem to gain their support.

3. The best ordinances and practices are of little benefit unless the practices are effectively maintained. In a study in Maryland, erosion and sediment control practices were functioning properly on less than 50 percent of the area studied (Fox 1975). My personal observations at numerous construction sites have supported this finding. I believe we must do more to educate contractors, foremen, and construction workers on the purpose of these practices. Some contractors on heavy construction sites have been very successful in achieving effective erosion control by educating their employees, and we should be able to do a better job of erosion control on urban sites.

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ATTACHMENT 1
(SCS 1977)

Runoff Management System (No. and acre)

Definition

A system for controlling excess runoff caused by construction operations at development sites, changes in land use, or other land disturbances.

Scope

This standard applies to the planning, design, installation, operation, and maintenance of runoff management systems, including adequate outlet facilities and components required for adequate management of storm runoff, as determined by site conditions.

Purpose

Mainly to regulate the rate and amount of runoff and sediment from development sites during and after construction operations to minimize such undesirable effects as flooding, erosion, and sedimentation.

Conditions where practice applies

This practice applies if there is a need to control runoff, erosion, and sedimentation to compensate for increased peak discharges and erosion resulting from construction operations at development sites or from other changes in land use. The discharges may be caused by such factors as increased runoff, reduced time of concentration, or reduced natural storage.

Design criteria

Overall. A runoff management system must be compatible with the flood plain management program of the local jurisdiction and with local regulations for controlling sediment, erosion, and runoff. The system, a single component or a combination of components, must properly regulate storm discharges from a site to a safe, adequate outlet. Consideration shall be given to the duration of flow as well as to the peak discharge. Adequate erosion-control measures and other water-quality practices must be provided. The components must be planned and designed to insure minimal impact on visual quality and human enjoyment of the landscape. Structures and materials must harmonize with surrounding areas.

The peak discharges from the 2-year and 100-year, 24-hour storms shall be analyzed. No increase in peak from these storms shall be allowed unless downstream increases are compatible with the overall flood plain management system.

Components. Components include but are not limited to dams, excavated ponds, infiltration trenches, parking lot storage, rooftop storage, and underground tanks.

Each component shall be designed according to sound engineering principles to insure that the system achieves its intended purposes. Design criteria for individual components shall be based on the following:

1. Dams shall meet the requirements specified in 40 - part 520, subpart C of the National Engineering Manual.
2. Excavated ponds shall meet the requirements specified for ponds (378).
3. The design of infiltration trenches shall be based on such factors as soil permeability, soil depth, seepage, quality of water to be temporarily stored, foundations for adjacent buildings and structures, drainage conditions, and vegetation. Other considerations are:

a. Only relatively clean water shall enter the trench to insure that oils, grease, and sediments do not seal trench walls and bottoms and thus reduce the effectiveness of the practice. At parking lots and at other areas having a similar contamination potential, filter strips; sediment traps; grease traps or filter traps, or both, shall be installed to remove objectionable materials from the water before it reaches the infiltration device. A strip of close-growing grasses at least 25 ft wide must be properly placed and maintained to insure the effectiveness of the trench. Water must move through the grass as sheet flow. If local site conditions warrant, a wider filter strip can be used.

b. Trenches shall be located above the seasonally high water table.

c. The size of the trench shall depend on the volume of storage required and the void ratio of the stones in the excavation. The volume of water infiltrating the walls and bottom of the trench during a storm shall be assumed to be zero in calculating the required volume. The permeability rate of the soil is used in determining the dewatering time, which shall not exceed 5 days.

d. The soils used for installing an infiltration trench must be well drained. If permeability of the surrounding soils is less than about 0.6 in./h, suitability of the site for an infiltration trench may not be practicable.

e. An infiltration trench must not adversely affect nearby foundations for buildings, roads, and parking lots and must not impair the growth of significant woody vegetation.

f. Stone used in the excavation must be poorly graded and about 1 to 2 in. in size.

g. In areas where spring runoff from snowmelt is likely to occur before the trench thaws, provisions shall be made for removing the excess water.

h. Provisions shall be made to insure that salts or other soluble pollutants entering the trench do not contaminate local water supplies.

i. The trench bottom and the stone surface must be level to insure adequate storage capacity and uniform infiltration.

4. Parking lot storage areas can be used to help control runoff from impervious paving. Most parking lot storage areas include small ponding areas that have an increased curb height and an outlet control structure. The following factors shall be considered in designing these areas:

a. This practice generally is used to control runoff from areas less than 3 acres in size.

b. The parking lot design and installation grades must insure positive flow to the storage area. The storage area must be nearly level, but the slope must be steep enough to facilitate drainage.

c. Trash guards must be provided to prevent clogging of the outlet control device.

d. Generally, ponding on the parking lot must not exceed 6 in. in areas where cars and light trucks are to be parked or 10 in. where heavy trucks are to be parked.

e. Emergency overflow outlets must be provided.

f. Such auxiliary practices as porous pavement and vegetative strips may be used in or adjacent to parking lots to permit infiltration.

5. For rooftop storage, the following requirements are applicable:

a. The roof shall be structurally capable of holding detained storm water and of withstanding the effects of high winds and snow. Requirements for structural stability are outside the scope of this standard and shall be determined by the building designer.

b. An adequate number of roof drains shall be provided.

c. Emergency overflow measures shall be provided to prevent overloading if roof drains become plugged.

d. Detention rings shall be placed around all roof drains in areas to be used for storage. The required number of holes or the size of openings in the rings shall be computed on the basis of the area of roof drainage per detention ring and the runoff criteria.

e. Maximum time of storage on the roof shall not exceed 24 hours.

6. The design of underground tanks shall be based on the following criteria:

a. The tank must be structurally capable of handling the anticipated loadings and be suited to the soils. Requirements for structural stability are outside the scope of this standard and must be based on sound engineering principles.

b. The outlet from the tank shall not be less than 5 in. in diameter. Provisions shall be made to prevent debris from entering the tank. Debris collectors shall be placed so that the need for maintenance can be readily detected and cleaning operations easily performed.

c. The bottom of the tank shall be on a slight grade to insure complete drainage of the tank.

d. Access must be provided to the tank to permit removal of sediment and other debris.

e. The maximum time of storage shall not exceed 5 days.

Sequence of installation. Components shall be designed and installed in a sequence that permits each to function as intended without causing a hazard. Single components shall not be installed until plans for the entire runoff management system are completed.

Safety. Appropriate safety features and devices shall be installed to protect humans and animals from such accidents as falling or drowning. Temporary fencing can be used until barrier plantings are established. Such protective measures as guardrails and fences shall be used on spillways and impoundments as needed.

Visual resources. Landscape architectural practices must insure that all measures are visually compatible with the surrounding landscape.

Protection. A protective cover of grasses shall be established on exposed surfaces and other disturbed areas. Other protective measures, such as mulches, also can be used. Seedbed preparation, seeding, fertilizing, and mulching shall comply with recommendations in technical guides for the area.

Operation and maintenance. A plan of operation and maintenance shall be prepared for use by the owner or others responsible for the system to insure that each component functions properly. This plan shall provide requirements for inspection, operation, and maintenance of individual components, including outlets. It shall be prepared before the system is installed and shall specify who is responsible for maintenance. Adequate rights-of-way must be provided for maintenance access.

Plans and specifications

Plans and specifications for runoff management systems shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

RETENTION BASINS FOR CONTROL OF URBAN STORMWATER QUALITY

Roger P. Akeley, AICP
Planning Coordinator, Environmental Programs Area
Southeast Michigan Council of Governments
Detroit, Michigan

Background and Purpose

The initial emphasis of the 1972 Federal Water Pollution Control Act Amendments focused on point sources of pollution; most notably municipal and industrial wastewater treatment facilities. As the 201 facilities planning program has progressed, significant reductions have been made in the pollutant loadings originating from point sources.

An increasing awareness has been developing regarding the significant pollutant contribution from nonpoint sources. In the heavily developed Southeast Michigan region, urban stormwater runoff, which washes litter, dirt, oil, salt and other pollutants into the region's waters, is a major contributor to water quality degradation. A variety of pollution control techniques, including source controls and on-site storage, can be implemented to mitigate the negative effects of this significant source of nonpoint pollution. A number of methods for the control of urban stormwater pollution have been explored by SEMCOG, including treatment facilities, on-site detention (with gradual release to receiving waters), combinations of treatment and storage, and source control programs. Source control programs include such nonstructural mechanisms as street sweeping, street washing, and leaf and litter pick-up programs. While all methods investigated have merit, the costs of most alternatives are high. However, the provision of on-site detention for water quality improvement in new developments appears to be cost-effective.

SEMCOG has received a grant from the EPA through its Nationwide Urban Runoff Program (NURP) to test and evaluate one of several "best management practices," which appears promising in reducing urban stormwater-associated water quality degradation in developing areas. EPA is funding approximately 30 NURP projects nationally.

The Southeast Michigan project is evaluating the effectiveness of stormwater retention basins for control of runoff water quality from subdivisions and commercial/light industrial development in Oakland County, Michigan. The hypothesis being tested is that stormwater pollution control in newly developed areas can be achieved with relatively inexpensive modifications to retention system design now used in control of stormwater quantity. If this hypothesis proves to be correct, retention systems could be regarded as an integral part of the developmental process, rather than as a last resort to be used only when there is insufficient pipe or channel capacity to receive increased stormwater quantity.

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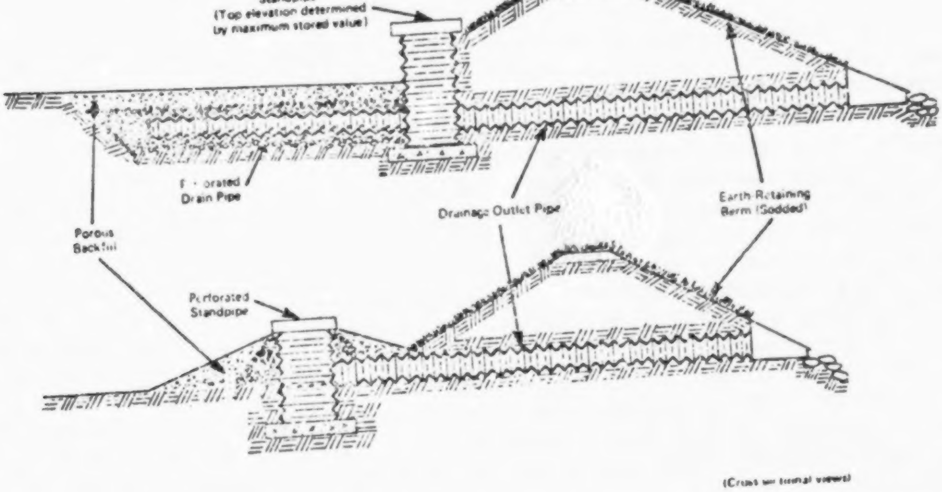
Retention systems are used in Michigan as the result of two state laws. The Soil Erosion and Sedimentation Control Act (MA 347) requires developers to obtain a sedimentation control permit from local enforcement agencies before beginning construction. A cutaway view of a sediment basin is depicted in Figure 1. Sediment basins are typically proposed for projects requiring substantial earth moving activity. These basins may be removed once the site has been fully stabilized. However, many of them are retained as permanent stormwater retention basins.

Figure 1

Typical Detention Basin Outlet Designs
for Suspended Solids Removal


Standpipe (Top elevation determined by maximum stored value)
Perforated Drain Pipe
Drainage Outlet Pipe
Earth Retaining Berm (Sodded)
Porous Backfill
Perforated Standpipe
(Cross sectional views)

The Subdivision Control Act (MA 288), as amended, requires local review of subdivision plats to insure adequate storm runoff control. On-site storage is required when the natural or constructed stormwater conveyance system is judged to be inadequate to handle increased flows.

Whenever lakes and streams prove to have adequate capacity to receive additional stormwater runoff, usually determined by calculating a 10-year storm capacity, stormwater outlets can discharge directly into receiving waters. Thus, there is no opportunity for the settling of suspended solids and associated pollutants.

Even when retention is currently required, basin design usually fails to maximize the potential for settling of pollutants. Often the inlet and outlets are in close proximity, so that basin discharge from small rainfall events occurs rather directly. Outlets, while sized smaller than inlets, are typically of the same elevation, again resulting in immediate discharge of small events. Many basins have no underdrains to promote infiltration. Also sediment control filters are removed for ease of maintenance, once Act 347 requirements have been met.

In sum, retention basins appear to be both underutilized and underdesigned in Michigan for purposes of comprehensive stormwater quality management. For newly developing areas, retention basins may be the most cost-effective way of ameliorating the negative impact of urban stormwater pollution. This cost-effectiveness must first be established if stormwater retention is to be utilized in a comprehensive preventive stormwater management system. The project conceived to establish this relationship is presented below.

Study Design

A two year sampling program has been initiated to test the effectiveness of retention basins. At least three residential and three commercial/light industrial catchments will be sampled during this time. Runoff in each basin will originate only from a single land use category. Sites are from three to fifty acres in size.

Figure 2 shows a residential retention system that has a wide, shallow basin where the sediment filter has been retained beyond the subdivision development period. The individual is standing on a berm next to the overflow channel. This retention area is used for recreation during dry periods.

Figure 2

Sediment Control Filter in an Oakland County
Retention Area (Residential)

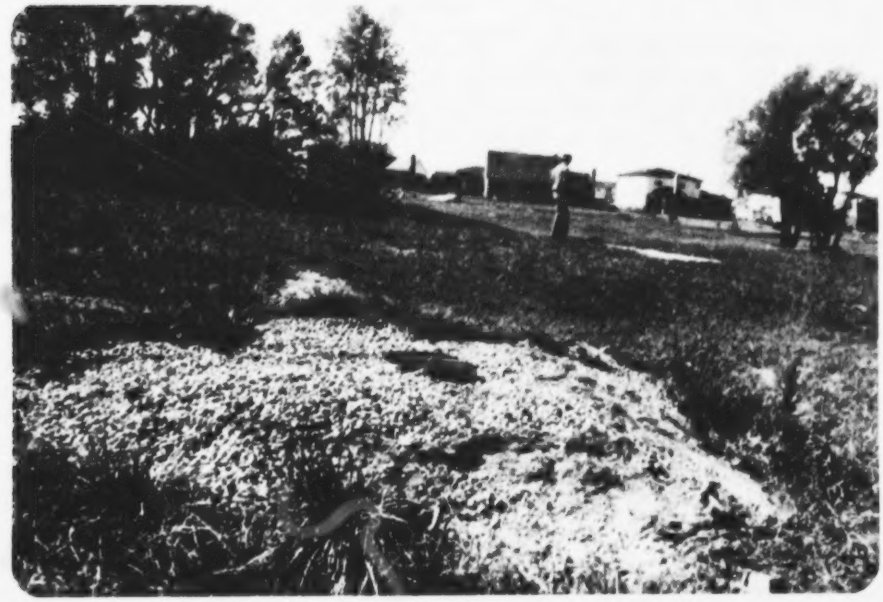
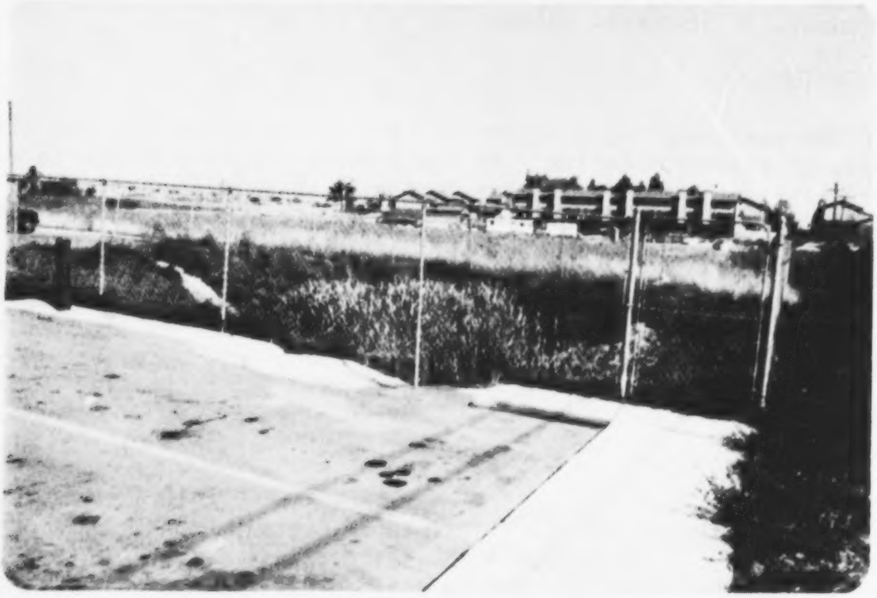


Figure 3 exemplifies a retention basin designed to handle 10-year storm frequency requirements in a minimum amount of space. It is tucked away in the corner of a fast food parking lot. Commercial and industrial sites are required to retain water on-site in areas where pipe and channel capacity are insufficient.

Figure 3

Retention Basin to Accommodate
Drainage from a Fast Food Parking Lot



Sites have been chosen in close proximity within Oakland County to help control for variability in rainfall. Land use categories are repeated in triplicate to help verify results and to permit control of modifications that will be made to basins during the project period.

A minimum of twelve rainfall and snowmelt events is being sampled for each site over the two year period. Automated samples and flow recording devices will be installed at the inlet and outlet of each retention basin in the Spring of 1980.

In order to monitor the performance of the retention basins in pollutant removal, a number of features will be assessed. These include: (1) snowmelt runoff quality, (2) rain runoff quality, (3) quality and quantity of discharge, (4) precipitation intensities and accumulations at 10-15 minute intervals, (5) particle size distribution of solids in influent and effluent of the basins, and (6) the quality of the residual materials removed in the basin. The program will use flow proportional composite sampling (intervals of equal discharge) to reduce analytical laboratory costs.

Rain events of various characteristics will be selected. Since most (80 percent) of storm events in an average year have total accumulations of 0.45 inch or less, particular attention will be given to monitoring the performance of the sites under these high intensity, short duration conditions.

The loadings of pollutants to and from the devices at each site will be calculated. The efficiency of each of the controls for any storm event will be evaluated as:

$$\frac{\text{total influent load}_{pi} - \text{effluent load}_{pi}}{\text{total influent load}_{pi}}$$

Where the total influent load for any pollutant (pi) is the load from one or more stormsewers tributary to the device, and the effluent load is that which enters the receiving water from the device.

The efficiencies of each device will also be evaluated with respect to precipitation patterns recorded at the sites. Hydrographs will be analyzed along with observations of conditions by field personnel.

In keeping with the project hypothesis that only inexpensive design modifications are necessary to convert existing stormwater retention systems into effective stormwater quality control devices, modifications similar to those presented in Table 1 will be considered for basins which currently don't have them.

Table 1

Possible Modifications to Existing
Stormwater Retention Systems for
Improvement in Stormwater Quality

- add gravel or cement for stabilization
- install baffle by inlet to reduce turbulence
- install barrier to compartmentalize basins
- increase infiltration capacity of basin banks or floor
- retain and maintain the sediment control filter after construction
- raise height of outlet pipe
- lengthen low flow conveyance distance between inlet and outlet pipes
- harvest and dispose of vegetation

With the exception of stabilization and vegetation harvesting, these modifications all work to increase the potential for settling of pollutants. The settling of suspended solids will be associated to some extent by a settling of nutrient and toxic materials. Ultimately, removal by settling requires an ongoing maintenance program, wherein accumulated material must be transported to an approved site. The costs and management requirements of such a maintenance program are being evaluated in the SEMCOG project.

SEMCOG's assessment is considering several factors related to the feasibility of utilizing stormwater quality retention basins:

1. Basin cleanout and disposal requirements
2. Safety and liability
3. Mosquito control
4. Responsibility for maintenance
5. Weed harvesting requirements
6. Filter maintenance
7. Vandalism
8. Legal aid cost

Thus, a detailed management performance analysis is accompanying the basin performance study. Both will provide substance to a guidebook for use by review officials and developers in planning for stormwater quality control in developing areas.

Indications of Effectiveness in Pollution Control

Early sampling results from another stormwater project (NURP) in Southeast Michigan are encouraging with respect to the effectiveness of a preventive retention approach to management of urban stormwater quality. The Washtenaw County Drain Commissioner has been studying several urban drains in Ann Arbor to determine the characteristics of urban runoff, both before and after it enters retention basins. This project differs from the Oakland County project in several respects:

- It involves wet basins rather than dry basins (ones designed to dewater after a storm event);
- It considers a mixture of urban and rural land uses in the test basins;
- It encompasses very large drainage areas, and;
- It concentrates on the effectiveness of an existing urban system, rather than exploring the impact of design modifications to small decentralized systems.

The work is, however, a useful indicator of the potential for retention systems to control pollution originating from urban watersheds. Early results in Washtenaw County help to document the extent of urban stormwater pollution in Southeast Michigan. Table 2 compares loadings from a major snowmelt event to equivalent loadings that would originate from Ann Arbor's wastewater treatment plant. While this table does not speak to the assimilative capacity of the Huron River, it does show a signification loading rate for suspended solids and biochemical oxgen demand when compared to the normal operations of the treatment plant.

Table 2
Loadings of Selected Pollutants
During Snowmelt Event, February 23, 1979
Ann Arbor, Michigan

	Total Loading for 5 Drains	Ann Arbor Treatment Plant Discharge lbs/day*	Equivalent Days of Treatment Plant Discharge Equal to 24 Hours Runoff Event**
TSS	114,400	1,670	68
TKN	2,000	830	2.4
Nitrate	1,181	1,670	.7
T-P	242	230	1.1
BOD_5	15,500	1,000	15.5

Note: Drain loadings are based on flow proportional composite samples and represent approximately 24 hours of discharge for this event (i.e. flow from melt occurred for approximately 24 hours before returning to base flow conditions).

* Assumes treatment plant flow of 20 MGD and effluent meeting tertiary plant standards.

** Number of days of treatment plant flow which would discharge the equivalent load measured during the 24 hour discharge from the storm drains.

Source: ENCOTEC, Inc. through Washtenaw County Drain Commissioner's Office

Table 3 indicates that, during this same event, a large percentage of suspended solids and nutrients were retained in Geddes Pond. The snowmelt removal rate of solids and phosphorus is especially interesting when compared to the removal percentages during a large summer storm. Solids associated with the snowmelt appear to be much coarser. perhaps caused by the grit that accumulates from winter road care activity. The coarser materials are more susceptible to settling.

Table 3

Capacity of Retention System to Remove Solids and Nutrients
Ann Arbor, Michigan

	Percent Removal		
Drainage Situation	Total Suspended Solids	Total Phosphorus	Total Kjeldahl Nitrogen
Geddes Pond February 22-26, 1979 (snowmelt)	89	63	15
Pittsfield Retention Area June 30 to July 6, 1979 (Total rainfall 2.9 inches)	44	25	22

Source: ENCOTEC, Inc. through Washtenaw County Drain Commissioner's Office.

Table 3 also demonstrates the relationship between phosphorus and suspended solids. Total Kjeldahl nitrogen acts independently, influenced largely by variation in basin characteristics. The data do indicate, however, that nitrogen levels are reduced through retention.

Heavy metals are also susceptible to treatment through retention. Removal percentages for the metals in Table 4 range from 6 to 89 percent.

Table 4
Capacity of Retention Systems to Remove Metals
Ann Arbor, Michigan

Drainage Situation	Percent Removal Zinc	Chromium	Cadmium	Copper	Nickel
Geddes Pond February 22-26, 1979	49	6	89	58	61
Pittsfield Retention Area June 30 to July 6, 1979	12	32	33	33	36

Source: ENCOTEC, Inc. through Washtenaw County Drain Commissioner's Office

Passive stormwater treatment systems deal with the insoluble portion of pollutants. The Washtenaw County work presents statistics on the insoluble fraction of four pollutants. The table shows considerable variability for each pollutant. However, even nitrogen is at times characterized by a large insoluble fraction.

Table 5
Insoluble Fraction of Selected Pollutants
Washtenaw County, Michigan

Snow Melt Survey, February, 1979 (Drain Outlets)

% Insoluble of Pollutant Load

	TKN	T-P	T-Iron	T-Lead
Allen Drain	23	75	99	93
Ann Arbor Pittsfield	20	84	99	98
Traver Drain	40	68	99	96
Swift Run Drain	13	76	97	--
North Campus Drain	29	90	98	97

Summer Storm - Ann Arbor-Pittsfield Retention Basin

% Insoluble*

	TKN	T-P	T-Iron	T-Lead
North Arm Inlet	58	80	>97	>97
South Arm Inlet	35	81	78	>95
Retention Basin Outlet	38	64	94	>95

* These values are flow weighted summary of samples for the entire event/runoff period.

Source: ENCOTEC, Inc. through Washtenaw County Drain Commissioner's Office

Particle sizes are also an important factor in the effectiveness of retention systems. Table 6 shows that particles sizes will vary due to basin characteristics and to storm characteristics. The design implications of this variance must still be determined.

Table 6
Particle Size Distribution For Selected Samples
June 30 - July 6 Retention Basin Survey
Washtenaw County, Michigan

	Micron Size	Distr. % By Weight		
		Sample 1	Sample 2	Sample 3
South Arm Inlet	>60	28	21	--
	10-60	54	32	29
	<10	18	47	71
North Arm Inlet	>60	13	21	29
	10-60	67	50	43
	<10	20	29	28
Outlet	>60	10	26	14
	10-60	20	34	29
	<10	70	40	57

Note: Samples correspond to initial phase of the event (#1), major portion of hydrograph, I.E. runoff (#2), and the tail of the event.

Sizing determined by pipet withdrawal technique, resulting in velocity settling data, size ranges determined by Stokes Law assuming a Spec. gravity of 2.65.

Source: ENCOTEC, Inc. through Washtenaw County Drain Commissioner's Office.

Summary

SEMCOG estimates that it would cost \$100,000,000, or \$200 per household, to implement a mandatory stormwater quality retention system in Southeast Michigan through 2000. Ongoing maintenance requirements represent an additional expense. Before such expenditures are required, they must be substantiated.

SEMCOG currently encourages careful design of retention basins, regardless of available drainage capacity, based on evidence presented in the literature and on the current work being performed by the Washtenaw County Drain Commissioner's Office.

In two years, SEMCOG expects to have reliable data to determine the cost-effectiveness of a decentralized stormwater quality control system that is built into the developmental process. The NURP grant will enable SEMCOG to make repeated water quality tests of retention basin performance, in sufficient detail to learn of the impact of design modifications.

Currently, maintenance requirements on retention systems for dry basins are minimal, since the basins are used primarily for temporary water storage. However, maintenance requirements may prove to be the primary determinant in the feasibility of initiating a comprehensive retention control program for water quality.

Final effectiveness of retention systems must be measured in terms of water quality goals for the region's lakes and streams. Toward meeting the fishable and swimmable water quality goals of PL 92-500, SEMCOG has identified several urban stormwater problem areas. SEMCOG will calculate the cumulative influence of retention system use, based on population projections, compared to the status quo. Total costs divided by total pounds of pollutants removed will provide a unit cost for using retention basins for water quality control in newly developed areas.

WETLANDS FOR THE CONTROL OF URBAN STORMWATER

Eugene A. Hickok
E. A. Hickok and Associates
Wayzata, Minnesota

INTRODUCTION

This paper will consist of two major areas of interest. The first area is a review of a research project performed to evaluate and assess urban runoff treatment methods using non-structural wetland treatment techniques. The results of this research have been published by the U. S. Environmental Protection Agency (EPA) as "Urban Runoff Treatment Methods - Volume I, Non-Structural Wetland Treatment."

The second area will be to show examples of the application of the technology gained from the research. Three projects that have been designed and constructed will be addressed.

BACKGROUND

The Minnehaha Creek Watershed District, organized in 1967, had as one of its primary objectives, the preservation of the water quality and water resources of the district.

The district is a natural watershed basin encompassing the area that drains into the Lake Minnetonka-Minnehaha Creek system. The largest and most prominent feature is Lake Minnetonka, whose 19 square miles of water make it the 10th largest lake in the state of Minnesota. From the lake's eastern edge at Grays Bay, Minnehaha Creek emerges to flow 22 miles in an easterly direction to the Mississippi River. Overall, the district encompasses 184 square miles on the western edge of the Twin Cities metropolitan area. Its major dimensions are 20 miles east-west by 15 miles north-south. There are 35 seperate units of government and dozens of other public and private bodies within the watershed district, with which the managers of the district maintain close working relationships.

Urban growth has generated water quality problems in many of the lakes and has caused the district to look for methods to improve the water quality of these lakes. A program of diverting effluent from the seven treatment plants that discharged to Lake Minnetonka was encouraged by the district as one means of improving water quality. Once the sewage was diverted stormwater runoff was identified as the major pollutant source to the lake.

Several communities within the district felt that wetlands play an important role in the lake ecosystem and these communities encouraged the development of hard data with which to evaluate wetlands scientifically. It has become apparent that wetlands could be a practical method to control stormwater runoff from a variety of developments and drainage areas. Indeed, wetlands have been identified as having a certain capacity for the renovation of polluted waters.

The Minnehaha Creek Watershed District applied for a U. S. Environmental Protection Agency grant to study the effectiveness of various methods of treating stormwater. The EPA offered a grant to the district and authorized it to proceed with the wetland studies. The district's consulting engineers and hydrologists, E. A. Hickok and Associates of Wayzata, Minnesota were retained to provide the necessary professional expertise for the project.

The site chosen for the study was a 7-acre wetland with a 70-acre watershed (shown on Figure 1). This 10 to 1 ratio of land surface to water surface is typical of many lakes and marshes in the region.

Appropriate instrumentation was installed in the wetland during the summer of 1974 and data collection continued through November 1975. The basic objectives of the project were to seek definitive answers to the following questions:

1. What role do wetlands play in the watershed's hydrologic cycle?

2. What is the character of runoff entering the wetlands?

3. What impact does runoff have on the wetlands?

4. What impact do the wetlands have on the quality of discharge water?

The general plan of study was to monitor all of the flows into and out of the wetland so as to develop a hydrologic balance. The quality of all the influent and effluent streams of the wetland was monitored and nutrient balances were developed. In addition, the internal transformations and biolgical activity in the wetlands were monitored during the project, and an environmental inventory of wildlife and vegetation was taken before and after the project.

THE PROJECT

The hydrologic cycle of any site is a complex series of interactions of water with plants, soil, and the atomosphere. The hydrologic cycle of the wetland study site is shown on Figure 2. The sources of water to the wetland are direct precipitation, surface runoff, and groundwater inflow. All of these influent sources were monitored as well as the surface outflow from the wetland and evapotranspiration.

The direct watershed of the wetland was subdivided into five drainage groups, based upon similar land use characteristics. A total of 13 subwatersheds comprised the five groups. Drainage

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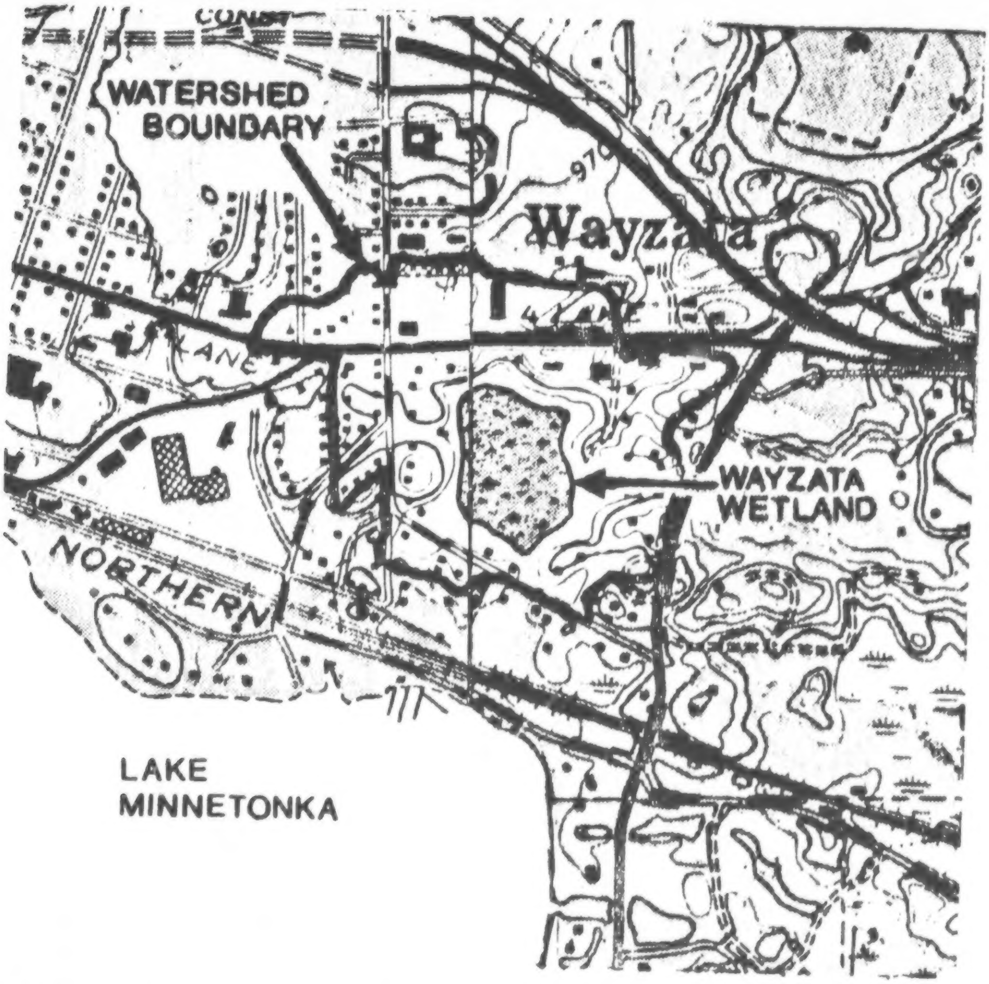

CONST
WATERSHED BOUNDARY
970
Wayzata
LANE
WAYZATA WETLAND
NORTHERN
LAKE MINNETONKA

Figure 1. Location Map - Wayzata Wetland

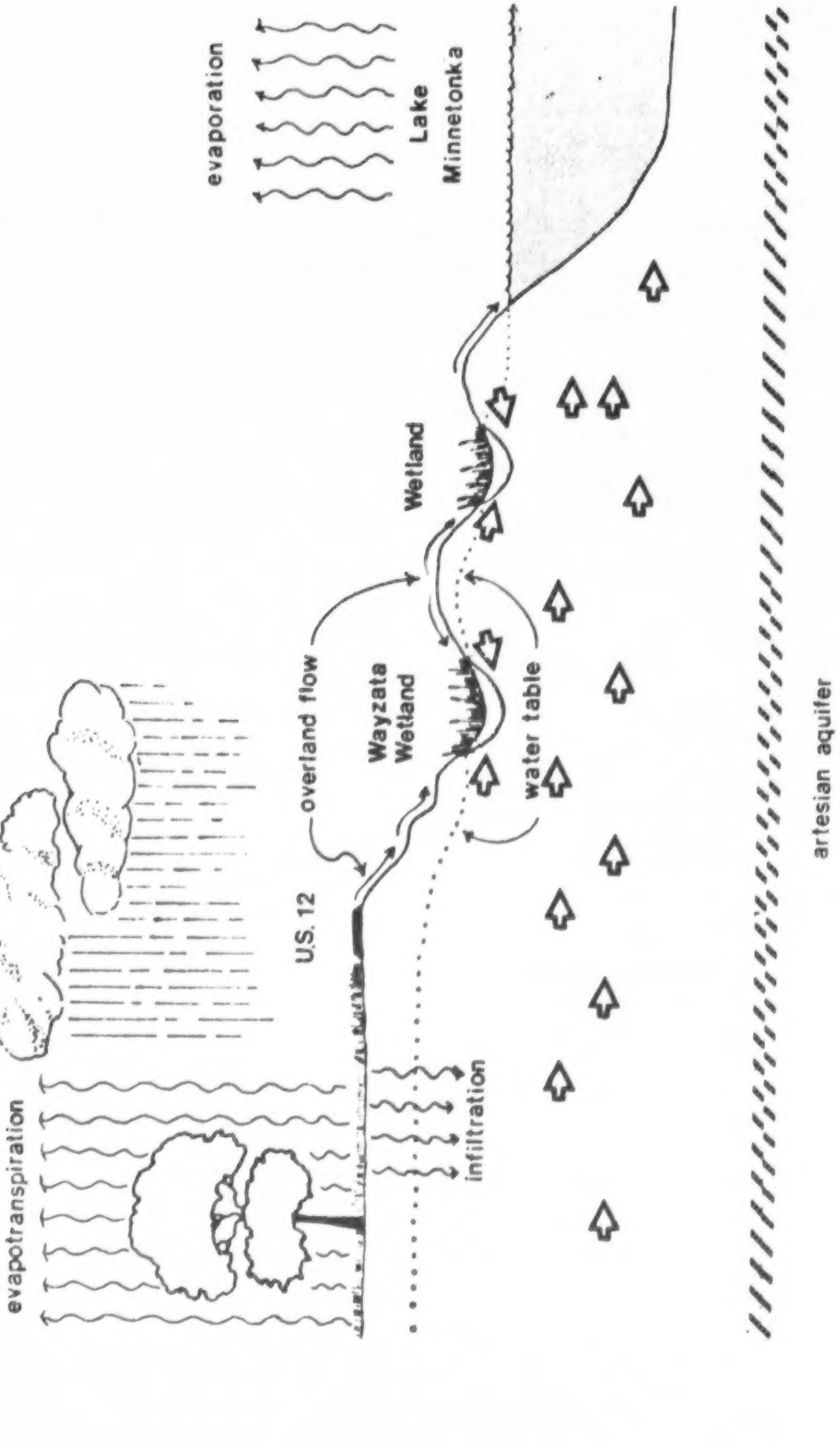

precipitation
evapotranspiration
infiltration
U.S. 12
overland flow
Wayzata Wetland
Wetland
water table
evaporation
Lake Minnetonka
artesian aquifer

Figure 2 Hydrologic Cycle

group I included areas that were typically undeveloped or had single family homes on large lots. Drainage group II consisted of single family homes on small lots. Drainage group III included areas occupied by small businesses located along a major traffice corridor. Drainage group IV included a major shopping center and runoff from major traffic corridors. Drainage group V included the wetland itself.

A wetland can be defined as land where the water table is at, near, or above the land surface long enough each year to promote the formation of hydric soils and to support the growth of hydrophytes, assuming other environmental conditions are favorable. From this definition it can be seen that groundwater is the most important physical factor in a wetland.

The wetlands instrumentation included five parshall flumes with automatic water samplers for monitoring surface runoff and outflow, thirteen groundwater observation wells and a complete weather station.

RESULTS

The water balance of the wetland for this study is shown in Table 1, below.

TABLE 1
WAYZATA WETLAND WATER BALANCE

GAINS (ac-ft)	
Direct Precipitation	19.3
Surface Runoff	25.9
Goundwater Inflow	9.7
	54.9
LOSSES (ac-ft)	
Evapotranspiration	14.5
Surface Outflow	44.1
	58.6
NET (ac-ft)	
DECREASE IN WETLAND STORAGE	3.7

The water balance shows that during the study period, the wetland storage was decreased by 3.7 ac-ft of water.

Phosphorus is the principle nutrient that degrades surface water in the Twin Cities Area. The phosphorus loading by drainage groups is shown in Table 2.

TABLE 2
PHOSPHORUS GENERATION BY LAND USE

Drainage Group	Phosphorus Concentration (mg/l)			Annual Phosphorus Load (lb/ac/yr)
	Spring	Summer	Fall	
I Single Family Large Lots	2.2	0.37	0.30	0.6
II Single Family Small Lots	2.4	0.73	0.42	0.9
III Strip Development Traffic Corridors	2.0	0.22	0.22	0.6
IV Shopping Center	1.9	0.09	0.25	2.1

The phosphorus concentrations for three seasons are shown in the first three columns and the annual phosphorus loadings are shown in the fourth column. It should be noted that the drainage group with the lowest concentration has the highest annual loading because of the greater total volume or runoff.

Table 3 shows the gains and losses for the wetland of phosphorus. A total of 134.7 lb/yr of phosphorus entered the wetland, of which 104.1 lb/yr was retained within the wetland. Therefore, 77 percent of the phosphorus that entered the wetland was retained.

TABLE 3
WAYZATA WETLAND PHOSPHORUS BALANCE

GAINS (lb/yr)	
Precipitation	1.5
Runoff	74.5
Groundwater	58.7
	134.7
LOSSES (lb/yr)	
Outflow	30.6
NET (lb/yr) RETAINED IN WETLAND	104.1

DISCUSSION

Four mechanisms are at work in the wetland system. These are physical entrapment, microbial utilization, plant uptake, and adsorption. Physical entrapment is an apparent reality in that 94 percent of the total suspended solids discharged to the wetland were retained. Following entrapment, nutrients are held in fibrous organic soil until the microbial utilization mechanism becomes operative.

Data developed by this project may be used to determine the pollutant loading generated by certain land use types and to determine the approximate wetland area required in a non-structural mode to renovate the stormwater runoff.

Table 4 shows the ratio by land use categories of developed area to the required treatment area. The table is based on the loading of phosphorus found during the project; however, other constraints could be applied and the results would be modified appropriately. Such constraints include allowable effluent concentration of a given parameter, the physical, microbiological, and chemical characteristics of the treatment area, and the hydrologic setting of the system.

TABLE 4
TYPICAL LAND REQUIREMENTS FOR NON-STRUCTURAL
RUNOFF TREATMENT SYSTEMS

Drainage Group	Ratio of Developed Area to[1] Wetland Treatment Area
I - Single Family, Large Lots	5:1
II - Single Family, Small Lots	3:1
III - Strip Development Traffic Corridor	5:1
IV - Shopping Center	1:1

(1) Using allowable loading rate of 2.9 lb/ac/yr of phosphorus.

CONCLUSIONS

1. Wetlands are a complex hydological, chemical, and biological system with each factor having impacts on the others.

2. The mechanism for the renovation of stormwater by wetlands appears to be a combination of physical entrapment, microbial transformation, and biological utilization.

3. The tributary phosphorus loading ranged from 0.6 lbs/ac/yr to 2.1 lbs/ac/yr from the undeveloped and single family drainage group to the shopping center drainage group, respectively.

4. The Wayzata wetland retained 77 percent of all total phosphorus and 94 percent of the total suspended solids entering the site during the study period.

5. The water level management technique, where effective, did appreciably increase the surface microbial activity.

6. Microbial activity decreased dramatically when wetland soils were submerged and became anerobic.

7. The biological assessments detected no adverse environmental impacts on the wildlife or vegetation within the wetland as a result of this project.

RECOMMENDATIONS

1. A general policy of wetland preservation for phosphorus removal with non-structural treatment methods should be adopted.

2. The drainage from selected wetlands should be managed and be aerated before discharge to receiving waters.

3. Careful consideration must be given to the distribution of stormwater to wetlands.

APPLICATION OF WETLANDS AND ORGANIC SOILS TO CONTROL URBAN RUNOFF

Three projects will be discussed in the following paragraphs, describing the application of the techniques developed in the previously discussed research.

During the initial planning phases of a new major regional shopping center, the environmental factors became a prime consideration. It was decided that facilities must be incorporated within the design of the development to reduce and control the impact of stormwater runoff. A report defining the hydrologic conditions of the site before and after the development was prepared and the required removal rates were determined so as not to impact the receiving waters. The drainage basin includes 112 acres of land, 88 acres of marsh, and 40 acres of open water. The shopping center occupies 85 acres of this land. The net effect of the development on the site was to increase the total stormwater runoff from 150 acre-feet per year to 368 acre-feet per year. It was estimated that over 70,000 pounds of suspended soils and 9,000 pounds of oil must be removed annually to maintain the present quality of the lake water.

Two stormwater holding ponds were designed and included in the original grading plan. These facilities were used during construction to store and settle stormwater runoff before discharge to the adjacent marsh and lake. The settled water was discharged through rock filter beds to remove suspended solids and silt. The granular material on the parking area was left a few inches above grade near the catch basins to prevent rapid runoff and erosion before the areas were paved.

The design objectives used to select a system and facilities included: (1) minimize the impact of the shopping center on the natural environment; (2) contribute only minimal increase to offsite discharge rate; (3) incorporate a water body with aesthetic appeal; (4) stabilize stream flows; (5) reduce flooding possibilities; (6) minimize erosion and siltation problems; and (7) utilize on-site drainage and storage capacity.

A baffled inlet control structure was utilized that captured the floating debris and grit before discharge to the holding pond. Belt type oil removal units were used at the outlet structures to remove any oil that had accumulated in the holding pond. One of the treatment areas was an intermittent pond with some peripheral wetland areas. Although the water elevation has been increased somewhat and fluctuates more widely than in the natural conditions, the site is aesthetically pleasant and the water quality meets the conditions of the National Pollutant Discharge Elimination System.

The second project utilizing technology gained in the research was the construction of a biologically activated soil filtration unit to filter phosphorus from the hypolimnetic bottom water of Wirth Lake in Minneapolis. A 3,600 square foot filtration unit with organic soil filter media was constructed. A filtration rate of 650 gallons per minute is being used to filter phosphorus and suspended solids from the hypolimnetic water. The unit was sized to be capable of filtering approximately one volume of the lake on an annual basis. The filtration unit has been planted with natural vegetation to enhance the aesthetic value of the unit as well as improve the nutrient renovative capacity of the organic soils. This system was installed during the summer of 1977.

The third project concerned a 225-acre watershed located at the Minneapolis-St. Paul Airport, which drained uncontrolled to a lake within the airport property. A facility was designed and constructed that included a 50,000 gallon oil retention basin and a 6-acre wetland treatment area. A filter dike permitting an unattended drawdown of the treated stormwater was constructed on the outlet of the wetland. This facility has been in operation since the fall of 1977.

STREAM RESTORATION: PHILOSOPHY AND IMPLEMENTATION

Nelson R. Nunnally, Ph. D.
University of North Carolina at Charlotte
Department of Geography and Earth Sciences
Charlotte, North Carolina

Introduction

Urbanization causes change in fluvial systems. Construction activities increase sediment discharge, change infiltration rates, and improve drainage efficiencies by constructing storm sewers and simplifying the drainage network. The main result of all these changes is a quicker response system with higher peak discharges, greater runoff columes, and increased frequencies of high discharges.

Leopold, Hammer, Monisawa and others have examined the effects of these altered discharge regimes on stream morphology. Initially, the increased sediment discharge produces bank deposition that increases the stream depth, but the long-term impact of increased discharges is greater bank erosion and streambed deposition which leads in an increase in width-depth ratios.

Streams in Charlotte, North Carolina had reached the point where bank erosion and streambed deposition had caused logjams and localized flooding problems of a magnitude sufficient to arouse concern among citizens and public officials.

Though there was pressure to channelize the streams, outright channelization was rejected as a solution because of the known impacts on fluvial systems and upon fish and animal habitats and cost. In addition, streams which have been straightened are notoriously unstable and have severe bank erosion problems.

In recent years there has emerged a philosophy for working with, rather than against, nature. The decision to improve streams in Mecklenburg County offered an opportunity to test some ideas for incorporating natural fluvial processes into channel design, and the term stream restoration was chosen to differentiate the process from usual channelization programs.

Stream restoration can be defined as a process for designing, constructing, and maintaining channels which restores the equilibrium conditions found in undisturbed natural channels while improving channel efficiency. The central theme in restoration is to try to preserve natural stream morphology wherever possible, and where change is essential, to try to design channels with morphological characteristics similar to those of natural channels. Thus channel straightening and changes in gradient should be avoided, and there should be minimal disturbance of the channel bed and banks, except where necessary to reduce erosion problems.

Implementation of the restoration concept involves three distinct phases--design, construction, and maintenance--each of which is important to the success of a program. This paper presents some alternatives to traditional procedures for designing alluvial channels.

Channel Design

None of the three traditional approaches to the design of stable channels is satisfactory for use in urban areas because of the wide, shallow channels that result from their application (Table 1). Alternate design procedures derived from fluvial relationships under equilibrium conditions were developed to size streams that drain urban watersheds.

Table 1

Comparison of Briar Creek Channel Dimensions
as Calculated by Alternative Methods

	Depth (ft)	Width (ft)	Area (ft^2)	Slope
Existing channel	4.2	11	81.2	.0018
Critical velocity	.6	419	252.5	.0018
Regime	4.1	41.5	206.1	.0018
Tractive force	.4	818	327.6	.0018
Recommended procedure	5.2	10.4	110.0	.0018

$Q_{2.0} = 505$

It is important to note that there is a substantial difference between equilibrium, as used here, and stability, as defined in the engineering literature. Equilibrium is defined as a dynamic balance among the components of a fluvial system that can be expressed mathematically as a set of relations among the statistical means of the components. If an existing equilibrium is disturbed and that disturbance, over time, results in a new equilibrium, then the old relationships would no longer apply and a new set would be required to describe the new equilibrium. A channel in equilibrium can undergo changes in channel location so long as the relationships among water and sediment discharge and channel morphology remain unchanged. A stable channel, on the other hand, is a special case of equilibrium in which channel location remains constant. Lane (1955) defined a stable channel as "an unlined earth channel that transports water and sediment without objectionable scour of banks and bed, and within which sediment does not accumulate to any significant degree." Under relatively constant environmental conditions any alluvial channel will evolve toward an equilibrium condition, but few, if any, natural channels which carry unsteady, non-uniform flow can be described as truly stable.

One of the major tenants of restoration is to design channels which are in equilibrium with existing or expected environmental conditions, and this means producing a channel adjusted to the discharge that it is expected to convey. Wolman and Miller (1960) have presented convincing arguments that the dominant channel forming flow is the bankfull event which has a recurrence interval of from 1.5 to two years based on the annual series. For this reason the two-year return interval discharge was selected as the design discharge for the restoration work on Charlotte streams.

Research has shown that bankfull discharge is closely related to drainage area. Because drainage area is easily calculated from maps or photos these relationships can provide a useful basis for design, even though there is considerable variability among basins. It would be unrealistic to expect all channels so designed to be in equilibrium because of variability in land use, soil types, and other factors. Nevertheless, most channels should be near the regression line unless they carry unexpectedly large discharges from watersheds which have undergone sufficient land use changes to invalidate the expected relationships between bankfull discharge and channel size. The problem of design is more complicated where such land use conversions and other disturbances have triggered changes which upset equilibrium in the system. Under these conditions it is useless to measure existing relationships among fluvial components with the intention of using them as a basis of design because they are in a state of flux.

Two things can be concluded from the studies of urbanization. First there is clearly a lag between land use changes and channel enlargement. The studies indicate a lag time of between 7 and 15 years, during which period the channel area may actually decrease due to sedimentation. Second, as the watershed becomes developed and construction ceases the sediment supply is dramatically decreased, but the frequency of bankfull flows is significantly increased, causing rapid bank erosion and channel enlargement.

Two basic issues need to be resolved. How much enlargement eventually occurs as a result of land use changes, and how long does it take a stream to re-establish equilibrium? Hammer (1972) addressed the first problem using a sample of small stream basins from the Pennsylvania piedmont. He found that the impact varied considerably for different land uses as can be seen in Table 2. When Hammer fit a regression line relating channel cross-sectional areas and drainage area for rural Pennsylvania streams his results were the same as the line which Dunne and Leopold calculated for the eastern United States. Hammer found that channels in urban and urbanizing areas had consistently larger cross-sectional areas. The ratios of actual cross-sectional area to expected cross-sectional area, which he called the enlargement ratio, were as high as 3.8, but most urban basins lay between 1 and 2.

Hammer was able to explain basin enlargement with a multiple regression equation that incorporated land use variables, an interaction variable, and two watershed parameters. His results, shown in Table 2 can be used, along with his equation to estimate the appropriate channel cross-section for a given projected mix of land uses in an urbanizing basin or for the existing mix of land uses in a fully developed basin. The major problem in using this approach is the effort required to measure land use, calculate the interaction variable, and determine the soil drainage index.

An alternative procedure which avoids these problems would be to use the enlargement ratios in Table 2 as multipliers for the corresponding percentages of the basin presently occupied or anticipated for each of the uses. This approach would produce a slightly over-designed channel because the negative effects of the soil drainage index and the watershed shape index are not included. It is this latter approach that is used as one of the design alternatives for sizing the channels for the Mecklenburg Restoration Project.

There are less accurate, but quicker, ways to use Hammer's findings to size channels. We took Hammer's data for urbanized basins and regressed channel cross sectional area against drainage area (Figure 1). The slope indicated that the effect of urbanization on channel enlargement decreases with basin size. One would expect this since the high discharges of localized storms would be "dampened out" on progressively higher order streams. The major problem in using this relationship as a basis for design is that it represents "average conditions." In the long run one would expect half the channels to be undersized. The effect could be especially serious in watersheds of one square mile or less where a major portion of the land eventually could be developed as residential or other uses that dramatically increase impervious area.

The channel enlargement effects found by Hammer are consistent with the increase in bankfull discharge frequency reported by Leopold (Hammer, 1971). Thus, it is possible to use the new discharge regimes that accompany urbanization as a basis for channel design. In Charlotte, the U.S. Geological Survey has mapped the expected extent of flood plains using projected land use development. The Step-Backwater program employed in this mapping project uses a simulated annual discharge series that allows any given return interval discharge to be estimated. Since the relationship between discharge and channel area has been well established, the expected discharge, based on anticipated basin development, can be used to size the channel.

Once a basin has been fully urbanized, and a sufficient period of time has elapsed to establish a new equilibrium, then there should be no need to enlarge a channel further. At the present time, however, there is little agreement as to the period of time necessary to recover equilibrium. Estimates range from a "half-life" of 17 years for headward erosion (which means that half the eventual adjustment occurs during that period) (Graf, 1977) to estimates of a few years required to restore

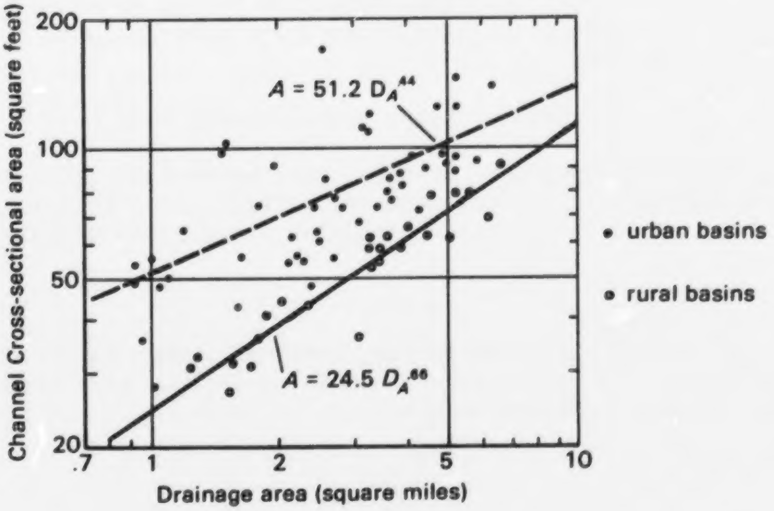
Results of Hammer's Channel Enlargement Study

Table 2

Independent Variable	Regression Coefficient	Enlargement Ratio for Land Uses
Land in cultivation	0.3896	1.29
Wooded land	-0.1518	0.75
Land in golf courses	1.6416	2.54
Houses more than 4 years old fronting sewered streets	0.8291	2.19
Sewered streets more than 4 years old	3.2499	5.95
Impervious areas more than 4 years old	3.7855	6.79
Nonimpervious developed land plus impervious area less than 4 years old; unsewered streets and houses	0.1870	1.08
Interaction variable: average slope of flow path to watershed mouth	0.2966	
Watershed shape index	-0.1990	
Soil drainage index	-0.1072	
Constant term	0.9025	

Multiple $R^2 = 0.9813$. Hammer 1972

Figure 1
Relationship Between Cross-Sectional Area and Drainage Area



equilibrium in small headwater streams after implementing a stormwater detention program.[1]

Recommended Procedure for Sizing Channels

Because of the uncertainty about the length of time required for the recovery of equilibrium, the suggested procedure for sizing channels in urban areas is to use the larger of (a) the existing channel area, or (b) the largest estimate of required area based on the following:

1) Use the equation relating cross-sectional area to discharge from Figure 1.

$$A = .86\, Q_{2.0}{}^{.81} \tag{1}$$

(Substitute $Q_{2.0}$ for $Q_{1.5}$ as a safety factor)

2) Use the relationship for urban basins in Figure 2 to calculate the expected channel size, given the drainage area.

$$A = 51.2\, D_A{}^{.44} \tag{2}$$

3) Use Hammer's multiple regression results and expected land use
patterns to calculate the enlargement ratio (R = .75 (percent
wooded) + 2.54 (percent golfcourses) + 2.19 (percent houses $>$
4 years) + 5.95 (percent sewered streets $>$ 4 years) (3)
+ 6.79 (percent other impervious area) + .9 (percent open)).
Multiply the expected cross-sectional area based on drainage
area by R to get anticipated equilibrium size (4)
($A = R\ 24.5\ (D_A)^{.66}$)

In many developed urban areas that have experienced limited recent land use changes stream cross-sectional area will have already achieved equilibrium size, but in developing areas or undeveloped areas that are expected to undergo development the formulas used in 1, 2, or 3 above will yield larger values. In some developed basins existing stream areas may be less than calculated areas where underdesigned bridges or culverts restrict flow.

Channel Shape and Alignment

Once the cross-sectional area has been determined it is necessary to select the appropriate channel geometry. Traditional techniques commonly used to shape channels are unacceptable in urban areas because the resulting channels are far too wide and shallow (Table 1). A trapezoidal channel shaped by the Bureau of Reclamation procedure is recommended for urban areas because it produces a compact channel which is compatible with urban environments and urban land uses. The formulas for the Bureau of Reclamation procedure are the following:

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[1] George Stem and William Weldon, personal communication. Both men were employed by SCS in the suburban Washington D.C. area when stormwater detention programs were implemented.

$$d = .5 \ A \qquad (5)$$

$$b = (4 - z)d \qquad (6)$$

Where Z is the bank slope expressed as a ratio of horizontal to vertical distance cross-sectional area in curved reaches can be enlarged by increasing channel width. In addition, inside banks are sloped to a 3:1 horizontal to vertical ratio, if possible, to more closely approximate natural meander cross-sections. Enlarging the cross-section accomplishes two objectives. It reduces scour in the bend, and it helps to keep the bankfull discharge within the channel. The latter is of minimal importance for Charlotte streams because of flood plain zoning. Rather, we have chosen to protect the banks with riprap where scour is expected (see the section on riprap design). The associated roughness of riprap has the additional advantage of creating secondary currents that have a tendency to stabilize the bend (Shen and Komura, 1968). One of the problems with increasing channel width is that there is no generally-agreed way of determining how much increase is necessary. Bagnold (1960) has suggested that a ratio of the radius of meander curvature to channel width (R/W) between two and three minimizes shear. Other studies limit the ratio to six or more (Lane, 1955). If there is reason to believe that the stream is in equilibrium the existing cross-sectional area of the meander can be used.

One of the fundamental precepts of restoration is that channels should not be straightened or relocated unless it is essential. The detrimental effects of channel straightening have been publicized in recent years, and as a result, many design procedures have been changed and many design manuals rewritten to discourage channel relocation and channel realignment. The following quote is indicative of this new awareness.

> Straight reaches should be avoided. ...The straightening of a truly meandering channel over long reaches should never be attempted. ...there are also many examples where the straightening of meandering channels in erodable materials has resulted in severe headcutting in the channel and tributaries, excessive widening as the stream attempts to reassert its meanders, and the dumping of eroding sediments upon downstream interests. (Vanoni, 1975, p. 526)

Bank Stabilization

Bank stabilization design begins with the shaping of the channel. It is imperative that bank slopes not exceed the angle of repose if the channel is in non-cohesive sediments. Proper shaping of banks helps reduce scour somewhat; but more importantly, it reduces undercutting of the toe slope and thereby reduces bank collapse. On Charlotte streams we have used 2:1 slopes in straight reaches and outside meander banks and 3:1 slopes on inside meander banks.

Despite the protection provided by proper shaping it is still necessary to take additional actions to stabilize the bank. These actions include leaving as many trees as possible and disturbing stable banks as little as possible, judicious use of riprap, and stabilizing disturbed banks by seeding. Guidelines employed in sizing and placing riprap can be found in *University of North Carolina Water Resources Research Institute Technical Report 144*, *Use of Fluvial Processes to Minimize Adverse Effects of Channelization.*

Preservation of Trees

Charlotte streams are headwater streams with drainage basins that range in size from less than one square mile to more than forty. Because of their relatively small size we have been able to use equipment such as hydraulic hoes, small bulldozers and tractors to do most of the work on these streams. This equipment is highly maneuverable so it is not necessary to clear one or both stream banks of trees as is the case when draglines are used. This has enabled us to leave trees outside the channel in place, except for occasional instances where removal of selected trees is necessary for equipment access.

Structural Protection

Although proper shaping of banks and establishment of vegetative cover provide sufficient stabilization of most banks in straight reaches, it is essential that outside meander bends and other bank sections exposed to rapid erosion be protected by structural methods. A variety of such methods exist, ranging from woven vegetative mats to attractive, but expensive, concrete and grass combinations. However, all but riprap were rejected for use on Charlotte streams because of aesthetic or cost reasons.

Riprap provides sufficient protection at low cost. In addition, if designed and placed properly, riprap is aesthetically acceptable
The main disadvantage to riprap use on urban streams has been found to be that of maintenance. Children persist on heaving or rolling the stones into the creeks and have virtually denuded bank reaches in several sections located near high density residential areas. This problem can be minimized by soiling and seeding the riprapped areas to promote rapid establishment of vegetative cover on the

riprap base.

The major design decisions in using riprap are 1) determining the proper size; and 2) deciding where and how much protection is needed.

Sizing the Riprap

Most procedures for calculating appropriate riprap size are overly conservative. We found that over-sized riprap produced several problems in Charlotte streams. First of all, large riprap is more expensive and more difficult to handle than smaller sizes. In the initial work on Briar Creek we used a mixture of riprap sizes with the largest stones sized according to procedures recommended by the Mecklenburg County Engineer (Mecklenburg County, 1975). In these sections Briar Creek is a small headwater stream with a two year design discharge of about 500 cfs, a cross-sectional area of approximately 90 sq. ft., and a bottom width of approximately 10 feet. Simply dumping riprap upon the banks was not satisfactory because the large stones, up to two feet in diameter, developed too much momentum and rolled into the creek. Some of these stones were too large to be hand placed back on the bank and required the use of the hydraulic hoe which was more time consuming and expensive than hand placement. Even the stones which did not roll down the bank during placement were frequently unstable on the slopes, and many were later rolled into the creek by children or rolled in as a result of undermining by erosion. It was virtually impossible to develop adequate vegetative cover to hide those large stones, and the result was somewhat unsightly.

Along subsequent reaches the riprap was sized according to Maynard's formula (Maynard, 1978) which resulted in smaller sizes. The smaller riprap proved to be easier to work with, more stable, and easily covered by vegetation. As mentioned previously, the main disadvantage of the smaller stone was that in residential areas children almost denuded the bank in a few places by heaving the stones into the channel.

Placement of Riprap

Perhaps the simplest solution to the question of what portions of a bank to riprap is to wait until a storm occurs then examine the bank for scour locations. Though a few sources advocate such an approach it must be weighed against the costs of sediment damage and, in some cases, repair work. We have adopted a policy of placing riprap where scour is expected, then supplying supplemental riprap if the need later becomes apparent.

Vegetative Stabilization

Once channel work has been completed it is important to stabilize any exposed bank and flood plain areas quickly. Soil Conservation Service guidelines have been followed very closely in planning, planting and maintaining seeded areas (SCS Technical Guide 342-IV, 1978). Plant selection should be made on the basis of site conditions and time of year. We have had good results with weeping lovegrass, sericea Lespedeza, fescue, and rye grass, depending on season and edaphic conditions.

SUMMARY

Restoration is by no means a cure-all for flooding or eroding urban streams. Though the general goal of restoration is to restore stream systems to a condition of equilibrium by preserving their natural morphological characteristics, there are two specific objectives: 1) improving flow efficiency by removing obstructions, both natural and unnatural, and 2) stabilizing stream banks to stop erosion by shaping, riprapping and seeding.

Streams with erodable banks cannot be completely stable; some erosion will occur, especially during major storm events. Neither are restored streams the most efficient channels that can be designed. They are, nevertheless, a reasonable compromise between the unacceptable extremes of rapidly eroding, inefficient channels that result from total neglect, and the expensive and efficient, but undesirable, results of channelization.

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METHODS FOR CONTROLLING EROSION AND SEDIMENTATION FROM RESIDENTIAL CONSTRUCTION ACTIVITIES

B. B. Hagman and J. G. Konrad
Residential Construction-Special Studies Section
Department of Natural Resources
Madison, Wisconsin

F. W. Madison, Environmental Specialist
Chief, Special Studies Section-Bureau of Water Quality
WI Department of Natural Resources
Project Director, Washington Co. Project, UW-Madison

Introduction

Stormwater runoff from residential subdivisions that are undergoing development can generate and transport large amounts of sediment and associate pollutants (nutrients, metals) to surface waters. Subdivisions constructed without preventative measures to reduce soil disturbance have been shown to contribute significantly to water quality nonpoint source problems (Washington County Project Final Report, in preparation). An investigation to examine uncontrolled subdivision development has been conducted in Germantown's Old Farm Annex located in Washington County, Wisconsin. The purpose of this study has been to examine the residential development process in order to make recommendations for minimizing and reducing sediment loss.

Two principal methods for controlling residential construction activities were studied with an emphasis on reducing or retaining sediment on site. The Annex plat had been developed; thus, with streets and utilities in place, individual housing construction was emphasized. On-site control measures and development practices that could be implemented without significant financial burden were examined. Methods for keeping the soil in place during the construction of dwellings rather than off-site remedies were stressed. Stormwater detention basins were not considered practical because the plat was already developed. The Village of Germantown was developing a land division control ordinance that required soil and water conservation planning. This regulatory mechanism was examined and recommendations made to include provisions for controlling individual home construction.

The subdivision development process, from site selection to home construction, is described in order to highlight issues of environmental concern. Housing construction is emphasized because this phase of development has not been critically evaluated as contributing to the sediment control problem. Existing publications describing construction erosion control measures emphasize plat development and off-site controls instead of on-site remedies. Control practices to minimize sediment loss during home building are discussed.

Mechanisms for regulating subdivision construction activities at the local level are also examined. Strengths and weaknesses of Washington County's and Germantown's subdivision ordinances are presented. Recommendations for improving cooperation and understanding between private development and environmental concerns are offered.

Several issues became apparent during this study. First, there is a need for information directed at developers, builders, and subcontractors describing how their working practices can cause serious environmental degradation, particularly to surface waters. In addition, practical and economical practices that minimize sediment loss on site are needed. Mechanisms are needed to provide incentives for subcontractors to examine the effect their actions have on sediment loss and transport. Lastly, cooperation between developers, builders and local government is necessary in order to better provide for the recommendation and implementation of sediment control practices.

DEVELOPMENT PROCESS

One of the best methods for minimizing erosion and sedimentation may be proper environmental planning prior to development. A high degree of quality may be achieved without increasing development cost; this is accomplished through proper selection of sites suitable for development and sensitive plat planning and development. The development process can be segmented in three phases: site selection and plat planning, plat development of streets and services and lot-by-lot house construction. These stages are described below and sediment control measures are suggested.

Site Selection

When investigating potential development sites, physical and natural conditions should be critically evaluated. Areas with unsuitable soil types, lowlands, steep slopes and high water tables (to name a few limitations) would be expensive to develop, requiring extensive filling or grading, difficult to minimize erosion, and troublesome to maintain. Preparation of the plat plan should take into account such factors as natural drainage patterns, existing vegetation and the amount of land disturbance necessary to develop the plat. An effort should be made by developers to minimize the degree to which the landscape will be altered particularly with respect to drainage. When necessary, erosion and sedimentation controls should be incorporated into the plat plan.

Plat Development

Plat development can be viewed as the construction of streets and services. Numerous publications have been written offering suggestions for reducing sediment loss during this stage. One common development practice has been to strip topsoil and vegetation from the entire plat then proceed with construction. Often the topsoil is stockpiled for several years while streets and services are being built. A more environmentally sound practice would be to only disturb the area where construction is currently concentrated or to protect large areas of exposed soil. If topsoil must be removed, temporary measures to protect the exposed soil should be taken. Seeding, mulching or other protective covers would achieve adequate control.

Other innovative measures can be implemented to minimize stormwater runoff; porous pavement and protective buffers or berms increase stormwater infiltration. It is critical that all control measures be incorporated into the plat plan, thus insuring enforcement and implementation.

Housing Construction

Construction of residential dwellings within a subdivision can cause large amounts of sediment to be transported through storm sewers to surface water. The problem is magnified by the simultaneous construction of several dwellings. Table 1 illustrates monitored sediment yield during uncontrolled housing construction (Washington County Project). Three subdivisions being rapidly developed were monitored during 1977. No treatments for erosion and sediment controls had been used. The amount of sediment, measured as suspended solids, leaving the subdivision through its storm sewer, has been estimated in kilograms per hectare per year. Differences in site conditions may account for variations in annual yield. No comparable values are currently available for treated residential construction activity.

TABLE 1

ANNUAL SUSPENDED SOLID YIELD (kg/ha)
FROM UNTREATED RESIDENTIAL CONSTRUCTION IN 1977

Station	Yield
G2	27,215 kg/ha
G3	17,365 kg/ha
G5	13,148 kg/ha

Building practices common during construction, that were examined in the Old Farm Annex, might be mitigated without interferring with construction. The following list, by no means complete, attempts to highlight damaging activities and conditions:

- Exposed and unprotected soil throughout the subdivision (highly erodible)
- Excavated soil, in large mounds, placed near and often in the streets (rapid erosion and delivery of sediment to storm sewers)

- Unlimited access to lots by vehicles and heavy equipment (tracking soil adhered to tires into streets; gullies formed by tire tracks that channelizes flow)
- Pumped water from flooded basements (dewatering) onto exposed areas (generates and transports sediment to storm sewers)
- Drained rooftop runoff onto unprotected areas (forms gullies, erodes and transports sediment to storm sewer system)

Many of these activities occur during work performed by subcontractors who are onsite for a very short time. Cooperation and communication between builders and subcontractors are essential if mitigating measures are to be effective.

ON-SITE CONTROLS

The following list of practices are divided into two categories, those that do not require additional funds to implement but are suggestions for timing activities to reduce impact. Other practices do have a minimal cost but are usually incurred at some point during construction. It is recommended that many of these measures be implemented early in the building process so that their benefit will be incurred throughout the housing construction period (which takes from four to six months).

No Cost Practices

1. Locate excavated basement soil a reasonable distance behind the curb, such as in the backyard or sideyard area. This will increase the distance eroded soil must travel to reach the storm sewer system.

2. Use only one route (perferably the future driveway) to approach the house with trucks and heavy equipment. This will reduce the impact vehicle traffic has on soil erosion.

3. Backfill basement walls as soon as possible and rough grade the lot. This will eliminate large soil mounds which are highly erodable and prepares the lot for temporary cover which will further reduce erosion potential.

4. Remove excess soil from the sites as soon as possible after backfilling. This will eliminate any sediment loss from surplus fill.

5. If a lot has a soil bank higher than the curb, a trench or berm should be installed moving the bank several feet behind the curb. This will reduce the occurrence of gully and rill erosion while providing some storage and settling area for storm water.

Other Practices

1. Cover an area behind the curb approximately 20-30 feet, if it is not feasible to stabilize the entire lot, with a protective material such as filter fabric or mulch and netting. This covering may be installed before backfilling, provided excavated soil is placed in the backyard area and the lot has been rough graded. Lateral lines may be installed by removing the protective covering and then replacing the cover after filling. This measure will reduce raindrop intensity while protecting the soil.

2. Apply gravel to the driveway area and restrict truck traffic to this one route. Driveway paving can be installed directly over the gravel. This measure will eliminate soil from adhering to tires and stops soil from washing into the street.

3. Install roof downspout extenders that aid in dispersing rainwater in a diffuse manner. This will reduce the runoff intensity from rooftops which can cause severe erosion.

4. If needed, cover side and/or backyards with mulch and netting or asphalt soil stabilizers after the house is backfilled. This will reduce erosion from these areas.

5. Stabilize lot by seeding and mulching or sodding as soon as is practical. This will minimize erosion as well as make the area more visually pleasant.

6. Provide for periodical street cleaning to remove sediment.

LEGAL CONTROLS CASE STUDY

Many states, counties and incorporated areas have enacted some type of ordinance that attempts to control subdivision developments. In Washington County, developers are required to submit preliminary plat plans to the County Soil and Water Conservation District for proposed developments within unincorporated areas. This subdivision ordinance is fairly modest requiring a land suitability test where lands with greater than 12 percent slope are presumed unsuitable for development unless developers can provide adequate erosion and sediment controls. The ordinance also requires stormwater management facilities be designed to handle the maximum flow potential from a 10-year 24-hour storm. If development requires substantial land disturbing activity, practices to minimize erosion and sedimentation are required. Several towns within the county have adopted the county ordinance.

Washington County's subdivison ordinance does not address the lot construction phase of development. It also does not apply to unplated housing construction (less than five lots). There are limited provisions for enforcement and penalties. Authorities are not defined stating who is responsible for monitoring compliance with this ordinance and insuring implementation of required erosion and sediment control measures.

The Village of Germantown has drafted a land division ordinance requiring plat review by the Village Engineer and County Soil and Water Conservation District. Maps of the natural and physical conditions within the proposed development are required in order to determine suitability. Soil and water conservation practices are also required where land disturbing activities are proposed. Developers are required to minimize the amount of area exposed and must stabilize by revegetating as soon as practical. In an attempt to control lot construction, the village is developing an ordinance that requires builders to post a cash bond when applying for a building permit. The bond will be used to pay for services, if any, incurred by the Village because of construction activity; any remaining money will be returned to the builder upon issuance of an occupancy permit.

Germantown's land division ordinance provides for inspection and enforcement by the Village Engineer during plat development. The Building Inspector inspects and enforces provisions of the building ordinance during lot construction. Fees have been set forth to pay for the plat review, site inspection and enforcement. This building ordinance is unique in that housing construction is controlled through building permits. The State of New Jersey uses this system to provide for statewide control of housing construction.

In order to provide for the control of erosive construction practices, subdivision and building ordinances should be strengthened to include:

- tracking provisions requiring vehicle traffic to clean sediment in the street as a result of their tire tracking;
- handling requirements for excavated soil so that soil is placed behind a set back line or tied to an egress line, from the house front to the curb line;
- placing limits on the amount of time soil can be exposed and require temporary protection;
- providing for the periodic cleaning of sediment from streets and gutters during construction;
- limiting alterations in natural drainage patterns or provide for retention of stormwater resulting from channelized drainage ways; and
- requiring that rooftop runoff be diffused onto vegetative areas and provide for the proper handling of pumped water (from dewatering or sump pump activity).

By including these provisions into ordinances that control land disturbing activities, environmental and aesthetic qualities will be greatly improved.

Recommendations for Controlling Sediment Loss

Land development for residential uses can cause sediment to be transported into waterways. Preventative measures are available which help to reduce sediment loss. Onsite controls tied to legal mechanisms could effectively reduce the impact urban land development may have on environmental quality. In order to provide the needed understanding and communication between local governments and private developers and builders there should be:

1. An education program, coordinated with state and local extension activities and soil and water conservation districts in order to explain the need for erosion and sediment control during development.
2. An information program directed at the building and supporting industries that emphasizes control measures as they relate to the work performed and their effect on environmental quality. Many state and local agencies, and labor or trade unions should cooperate in designing and implementing an informational program.
3. The development of design standards and specifications for sediment control, in laymans language to be implemented during plat development and housing construction. Agencies such as the Soil Conservation Service, State Departments of Natural Resources and Universities should cooperate in the development of brochures and nontechnical guides.
4. A program involving local officials, developers, builders and subcontractors in order to set reasonable regulations if needed.

COST EFFECTIVE ANALYSIS OF CONSTRUCTION EROSION CONTROL AND IMPLICATIONS FOR PLANNING IN SOUTHEASTERN WISCONSIN

David B. Kendziorski, Senior Water Quality Planner
Southeastern Wisconsin Regional Planning Commission
Waukesha, Wisconsin

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INTRODUCTION

The Southeastern Wisconsin Planning Region, as shown on Map 1, is comprised of seven counties in which about 40 percent of the State of Wisconsin's population live on about 5 percent of the state's land area. By the year 2000, urban development within the Region is expected to increase by 22 percent over the 1970 level. Water resources affect, and are affected by, the physical development of southeastern Wisconsin. The large resident population, the highly industrialized economy, the areawide diffusion of urban development, the demand for a variety of recreational opportunities, and the need for the preservation of valuable natural resources combine to make the proper management of water resources particularly important.

Properly managed, water resources constitute a valuable asset to the residents of southeastern Wisconsin. Misused and mismanaged, however, these resources will become the focus of serious and costly developmental and environmental problems and place severe constraints on the sound social, economic, and physical development of this urbanizing Region. Water pollution is one manifestation of the misuse of land and water resources; and the public has become increasingly aware of, and concerned over, such pollution, which has seriously interferred with desired water uses. One of the primary pollution sources in urban areas to which this concern is directed, is construction activity.

Map 1

SOUTHEASTERN WISCONSIN REGION

Construction activity can contribute a variety of pollutants to surface waters - including sediment, phosphorus,

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nitrogen, oxygen-demanding substances, toxic or hazardous substances, grease, and oil. Sediment is the most visible pollutant generated from construction activities. This eroded sediment may clog culverts and road ditches, cause localized flooding as the surface drainage patterns are disrupted, create an aesthetic nuisance, interfere with navigation, and cover valuable benthic habitats. Sediment particles also act as a transport mechanism for nitrogen, phosphorus, pesticides, heavy metals, and organic substances. This paper will focus on one of these pollutants which is often attached to sediment particles, namely phosphorus. Phosphorus is an important pollutant in many of southeastern Wisconsin's surface waters and construction activity contributes a large percentage of the total phosphorus load within the Region. Phosphorus stimulates excessive growths of algae and aquatic weeds, which interfere with the recreational use of the water. As these plant masses die and decompose, dissolved oxygen depletions may result which threaten the survival of fish and aquatic life. Under certain conditions, one pound of phosphorus may produce 1,000 pounds or more of aquatic plant material. Upon the decomposition of this amount of plant material generated from one pound of phosphorus, about 100 pounds of dissolved oxygen may be consumed.

Water pollution control and soil conservation experts at local, state, and federal levels of government have, for years, recommended the application of construction erosion control practices. These recommendations were based on the concept that, since construction site erosion is a relatively severe, although localized and short-term problem, its control constitutes "proper" land management. However, this limited approach to erosion and sediment control has not been totally effective. As a result of the recent interest in nonpoint source pollution and the water quality planning efforts of the designated '208' agencies, many state and local agencies have considered regulations to require the control of construction site erosion. From a water pollution perspective, these regulatory frameworks are based upon the premise that lakes and streams are, in fact, degraded by construction generated pollutants and that control of construction erosion is a cost-effective approach to water pollution abatement.

The purpose of this paper is to present a cost-effectiveness comparison of construction erosion control to other methods of water pollution abatement, to discuss the importance of construction erosion and its control within the context of an areawide water quality management plan, and to explain the recommendations of such a plan recently developed for southeastern Wisconsin.

METHODOLOGY

The Southeastern Wisconsin Regional Planning Commission recently completed an areawide water quality management or '208' plan for the Region. The plan addressed all point sources of water pollution, which include sewage treatment plant outfalls, sanitary and combined sewer flow relief devices, and industrial wastewater discharges, and all nonpoint sources, which include urban and rural land runoff, construction site erosion, livestock operations, groundwater inflow, and atmospheric contributions. The existing water quality conditions of the Region's lakes and streams were analyzed, all sources of pollution were identified and quantified, and a plan was designed to achieve, where practical, "fishable and swimmable" waters.

The unit costs and the estimated pollution abatement effectiveness--in terms of phosphorus reductions--of nonpoint source controls developed in the plan are set forth in Table 1. All costs are in 1976 dollars.

Table 1

UNIT COSTS AND POLLUTION ABATEMENT EFFECTIVENESS
OF NONPOINT SOURCE CONTROLS

Nonpoint Source Control Measure	Unit Cost[a]	Assumed Level of Phosphorus Reduction Achieved[b]
Construction Erosion Control	$2,600/acre construction	90%
Livestock Waste Control	$16/animal/year	90%
Urban Land Management-		
Minimum	$10/acre/year	25%
Additional	$125/acre/year	50%
Rural Land Management-		
Minimum	$2/acre/year	25%
Additional	$5/acre/year	50%
High Level	$24/acre/year	75%

[a] All costs are in 1976 dollars.

[b] Based on phosphorus reduction estimates set forth in SEWRPC Technical Report No. 18, State of the Art of Water Pollution Control in Southeastern Wisconsin.

The construction erosion control cost of $2,600 per acre probably represents a conservatively high estimate of the costs that may be expected.[1] The cost estimates were based on a typical construction site sediment and erosion control plan[2] which included a diversion dike, a sediment retention basin, straw bales, surface mulch, and seeding. The remaining costs and pollution abatement effectiveness estimates shown on Table 1 are based on SEWRPC Technical Report No. 18, State of the Art of Water Pollution Control in Southeastern Wisconsin, which was prepared at the onset of the '208' planning program. These estimates are difficult to make, and represent regional soil and hydrologic conditions and costs.

In order to quantify sources of pollutants, the Regional Planning Commission developed pollutant loading rates from nonpoint sources based primarily on values reported in the scientific literature. Subsequent to the development of the areawide plan, the International Joint Commission's (IJC) Menomonee River Pilot Watershed Study,[3] which was conducted to quantify pollutant loads from land use activities, resulted in published annual phosphorus loading rate estimates. These IJC phosphorus loading rates were used in the cost-effective analysis presented in this paper.

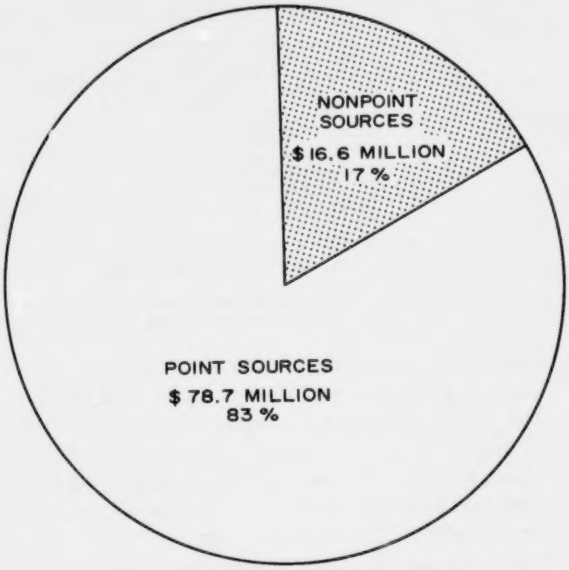
For the purposes of this paper, the term "cost-effectiveness" refers to the cost required to control one pound of phosphorus. Accordingly, the most cost-effective practice would control the most phosphorus for the least cost. The technique used in the cost-effective analysis is to divide the estimated control cost by the amount of phosphorus expected to be controlled. This was conducted for both nonpoint and point source controls. It is important to note that this is a "systems level" analysis, based on generalized cost estimates and phosphorus loading rates. The relative cost-effectiveness of construction erosion control and any other pollution control measure is highly site specific, and would also vary for other pollutants, such as sediment.

DISCUSSION

The total cost of all recommended water pollution abatement activities in southeastern Wisconsin for the period of 1975 to the year 2000 is an estimated $2.4 billion, including capital and operation and maintenance costs in 1976 dollars. Of the total average annual capital and operation and maintenance cost of $95 million, as shown in Figure 1, nonpoint source controls account for $17 million, or 17 percent, with point source controls requiring the remaining $79 million, or 83 percent. Construction erosion control--as shown in Figure 2--has an estimated average annual cost of $7.4 million, or 45 percent of the nonpoint source control cost and 8 percent of the total pollution abatement cost. Since typically, based on 1975 land use data, only about 2 percent of the area of the Region is expected to be undergoing construction activity in an average year, a relatively large portion of the total nonpoint source control cost is required to control pollutant runoff from a relatively small portion of the land area.

FIGURE I

TOTAL ANNUAL CAPITAL AND OPERATION AND MAINTENANCE POLLUTION ABATEMENT COSTS SOUTHEASTERN WISCONSIN



TOTAL POLLUTION ABATEMENT: $95.3 MILLION

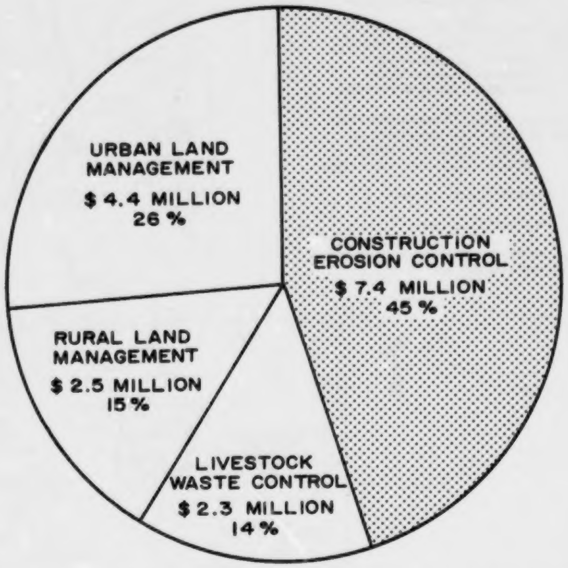
By applying a unit load of seven pounds of phosphorus per acre of land under construction per year, it is estimated that construction activities contributed about 15 percent of the total phosphorus load--equivalent to about 28 percent of the estimated nonpoint source phosphorus load--to the inland lakes and streams in southeastern Wisconsin, as of 1975. As shown in Figure 3, other important phosphorus sources to inland lakes and streams included point sources, which accounted for 48 percent of the total load, and agricultural nonpoint sources, which contributed

28 percent. Map 2 presents the inland watersheds of the Region, shown in white; the direct tributary area to Lake Michigan, shown in grey; and the proposed sanitary sewer service area served by sewage treatment plants which discharge directly to Lake Michigan, shown in cross-hatch. The phosphorus contributions to inland lakes and streams just discussed exclude the nonpoint source loads from the direct drainage area to Lake Michigan and the sewage treatment plant loads discharged directly to Lake Michigan. If the entire Region is considered--including direct pollutant discharge to Lake Michigan, point sources contribute a higher proportion of the total phosphorus load--about 75 percent, as compared to the 48 percent point source contribution of phosphorus to inland lakes and streams. The pollution abatement costs previously discussed represent total regional costs--including the abatement of direct discharges to Lake Michigan.

Based on phosphorus loading, pollution abatement effectiveness, and unit cost estimates, construction erosion control is among the most cost-effective means of reducing nonpoint source phosphorus loads to surface waters. Figure 4 sets forth the cost-effectiveness, expressed as the cost per pound of phosphorus controlled, of each of the nonpoint source control categories developed under the Commission's areawide planning program. The cost effectiveness of construction erosion control, at about $31 per pound of phosphorus controlled, may be compared to livestock

FIGURE 2

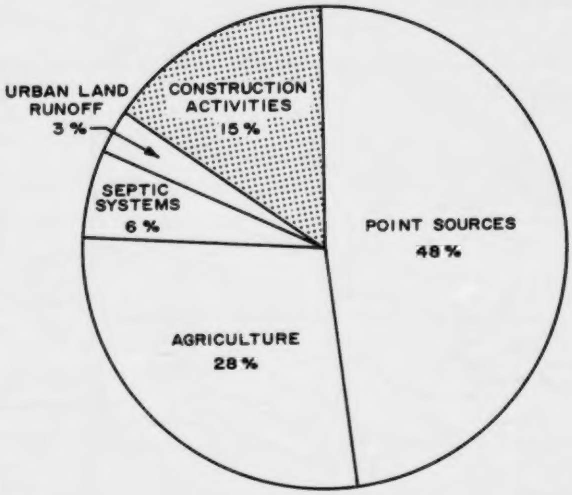
ANNUAL CAPITAL AND OPERATION AND MAINTENANCE NONPOINT SOURCE CONTROL COSTS SOUTHEASTERN WISCONSIN



TOTAL NONPOINT SOURCE POLLUTION: $16.6 MILLION

FIGURE 3

SOURCES OF PHOSPHORUS TO INLAND LAKES AND STREAMS IN SOUTHEASTERN WISCONSIN: 1975



Map 2

POLLUTANT LOADING ANALYSIS AREAS FOR SOUTHEASTERN WISCONSIN

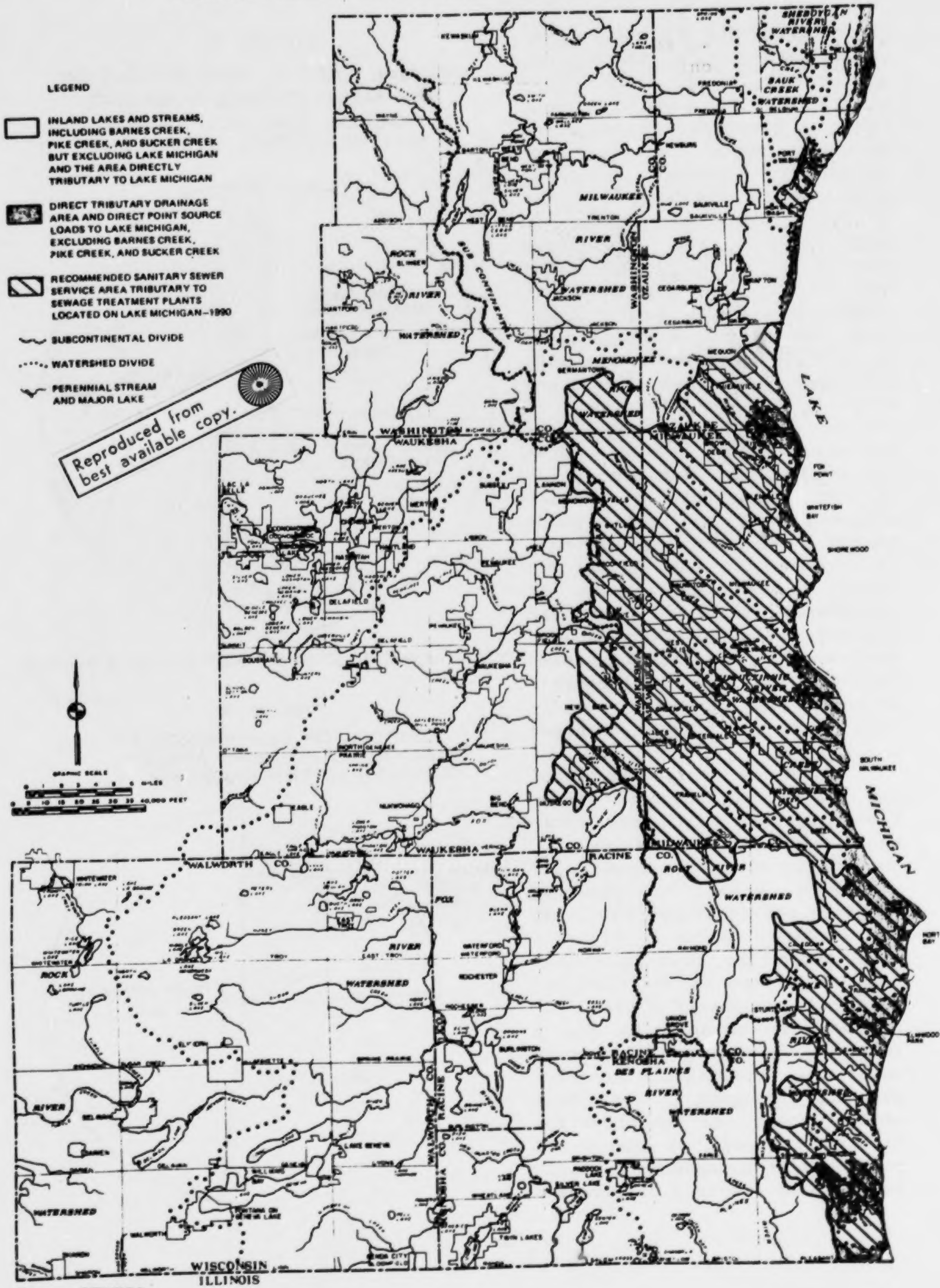

LEGEND
☐ INLAND LAKES AND STREAMS, INCLUDING BARNES CREEK, PIKE CREEK, AND SUCKER CREEK BUT EXCLUDING LAKE MICHIGAN AND THE AREA DIRECTLY TRIBUTARY TO LAKE MICHIGAN
▦ DIRECT TRIBUTARY DRAINAGE AREA AND DIRECT POINT SOURCE LOADS TO LAKE MICHIGAN, EXCLUDING BARNES CREEK, PIKE CREEK, AND SUCKER CREEK
▨ RECOMMENDED SANITARY SEWER SERVICE AREA TRIBUTARY TO SEWAGE TREATMENT PLANTS LOCATED ON LAKE MICHIGAN—1990
SUBCONTINENTAL DIVIDE
WATERSHED DIVIDE
PERENNIAL STREAM AND MAJOR LAKE
GRAPHIC SCALE
MILES
FEET
SHEBOYGAN RIVER WATERSHED
SAUK CREEK WATERSHED
MILWAUKEE RIVER WATERSHED
ROCK RIVER WATERSHED
SUBCONTINENTAL
MENOMONEE WATERSHED
WASHINGTON CO.
OZAUKEE CO.
WAUKESHA CO.
MILWAUKEE CO.
WALWORTH CO.
RACINE CO.
KENOSHA CO.
ROOT RIVER WATERSHED
FOX RIVER WATERSHED
DES PLAINES RIVER WATERSHED
RIVER WATERSHED
LAKE MICHIGAN
WISCONSIN
ILLINOIS

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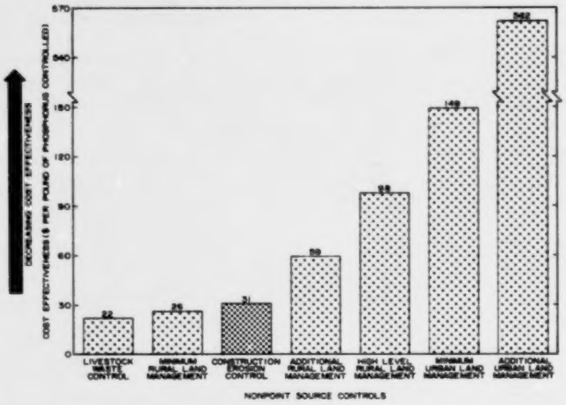
FIGURE 4

COST EFFECTIVENESS OF NONPOINT SOURCE CONTROLS FOR PHOPHORUS REDUCTIONS



waste control, at $22 per pound of phosphorus controlled, and to minimum rural land management practices, at $26 per pound of phosphorus controlled. While somewhat less cost-effective than these basic agricultural management practices, erosion control is two to three times more cost-effective than additional, more intensive agricultural phosphorus runoff controls, at $59 to $98 per pound of phosphorus controlled; about five times more cost-effective than minimum urban land management practices, at $149 per pound; and nearly 20 times more cost-effective than intensive urban nonpoint source control practices, such as increased street sweeping, at $562 per pound.

Construction erosion control is relatively cost-effective for three reasons. First, since the land area eroding is usually small, the extent of the application of practices can also be small, thereby reducing costs. Second, the primary pollutants generated by construction activities--namely sediment and phosphorus which itself is usually attached to sediment particles--are easier to control than soluble phosphorus or other dissolved pollutants. Third, phosphorus loads from construction activities on a per acre basis are relatively high compared to loads from other nonpoint sources. Therefore, by stabilizing the land surface and eliminating excessive loadings, a large percentage reduction in the pollutant load can be achieved.

While construction erosion control is a relatively cost-effective method of reducing nonpoint source phosphorus loads to surface waters, sewage treatment techniques are generally more cost-effective at reducing phosphorus contributions than many nonpoint source controls. Table 2 sets forth the cost-effectiveness of septic systems and several treatment levels for both small and large treatment plants. Septic systems and smaller treatment plants, which serve populations of up to 2,500 persons, have a cost-effectiveness estimated at about $13 to $30 per pound of phosphorus controlled, which approximate the most cost-effective nonpoint source controls, including construction erosion control. Larger treatment plants, which serve populations of up to 50,000 persons, are significantly more cost-effective than any of the identified nonpoint source control categories, ranging from about $7 to $15 per pound. A summary of the cost-effectiveness of the various pollution abatement activities is set forth in Figure 5. Many nonpoint source controls are less cost-effective than point source controls. However, it is worthy of note that the most cost-effective nonpoint source abatement measures, such as some agricultural controls and construction erosion control, are nearly as cost-

Table 2

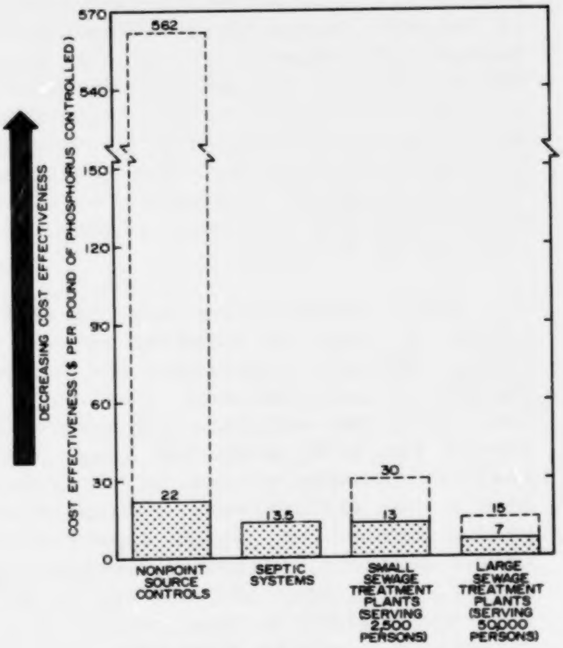
COST EFFECTIVENESS OF PROPERLY OPERATED SEWAGE TREATMENT MEASURES FOR PHOSPHORUS REDUCTIONS

Sewage Treatment Measure	Service Population	Sewage Treatment Level	Percent of Influent Phosphorus Removed By Treatment	Cost-Effectiveness ($ Per Pound of Phosphorus Removed)
Properly Functioning Septic Systems	--	--	95	13.5
Sewage Treatment - Plant	2,500	Secondary	30	29.7
		Conventional-P Removal	90	12.9
		High Level-P Removal	99	20.0
		Land Application	100	16.8
Sewage Treatment Plant	50,000	Secondary	30	15.1
		Conventional-P Removal	90	7.4
		High Level-P Removal	99	8.9
		Land Application	100	8.9

effective as the engineered sewage treatment techniques which have been the focal point of much of the pollution abatement efforts within the United States throughout this century.

FIGURE 5

SUMMARY COST-EFFECTIVENESS OF POLLUTION ABATEMENT MEASURES



It would be misleading to suggest that this cost-effectiveness analysis for phosphorus is representative of the cost-effectiveness of pollution abatement measures for all water pollutants. Cost-effectiveness is highly dependent on the uncontrolled pollutant loads from various sources, and on the level of reduction of a pollutant achieved by the implementation of a control practice. For example, construction erosion control is not a cost-effective means of reducing fecal coliform loads to streams, whereas livestock waste control is extemely cost-effective in this regard. Similarly, construction erosion control is generally not a cost-effective way of reducing nitrogen or biochemical oxygen demand loads to surface waters, since it is estimated that construction activities contribute only about 5 percent of the total load of these pollutants. However, because construction erosion contributes about one-third of the total load of sediment to surface waters in southeastern Wisconsin, and because a large reduction in sediment loads is achievable, erosion control can also be expected to be a relatively cost-effective means of reducing sediment loads.

If local public officials erroneously believe that construction erosion control is not practical, cost-effective, or worth the increased efforts required, and therefore, construction erosion control is not implemented in southeastern Wisconsin, significant effects on water quality are likely to occur. Shown in black on Map 3 are those lakes and streams which, if construction erosion control were not implemented, would not satisfy "fishable-swimmable" standards, and which could otherwise do so under year 2000 conditions if the remainder of the '208' plan were implemented. These designations are based on phosphorus loading estimates from various pollution sources and on the results of water quality simulation modeling studies which were conducted to determine the effects of alternative levels of pollution control. These surface waters amount to about 108 stream miles, or 9 percent of the total stream miles, and 34 of the 100 major lakes in the Region. This map shows the significance of potential construction erosion pollution in southeastern Wisconsin. These lakes and streams, which are not expected to be "fishable-swimmable" unless effective construction erosion control is implemented, include some of the most important fishery resource and recreational use waters in the Region and in the entire State of Wisconsin. It should be noted that these construction erosion effects are conservative in that they assume that the Regional Planning Commission's land use plan will be implemented. Based on current trends, more urban development may occur than as planned by the Commission, and the water quality effects are likely to be even more widespread and severe than indicated on this map. The construction affected lakes and streams shown on this map also do not include those lakes and streams, located in primarily urban areas and shown as dashed lines on the map, which may not meet "fishable and swimmable" standards under the final recommended '208' plan, but which could get progressively worse if construction erosion control were not implemented.

IMPLICATIONS FOR WATER QUALITY MANAGEMENT IN SOUTHEASTERN WISCONSIN

The control of construction erosion has significant implications for water quality management in southeastern Wisconsin. To facilitate the control of construction site erosion, the Regional Planning Commission has recommended that formal construction erosion control regulatory programs be implemented by the appropriate local agencies. These agencies include all seven of the counties in the Region and all of the incorporated municipalities. It was recommended that the counties, and all cities and villages review and revise, if necessary, their subdivision regulations, zoning ordinances, and building codes to ensure minimization of erosion during construction periods. Although model provisions relating to erosion control and designed to be incorporated into regulations, ordinances, and codes were suggested, the strictness of the regulations, the specific control techniques required, and the methods of compliance evaluation and enforcement were left to be determined by the local designated management agencies through a second level planning effort. The county soil and water conservation districts were recommended to provide

MAP 3

WATER QUALITY CONSEQUENCES OF FAILURE TO IMPLEMENT CONSTRUCTION EROSION CONTROL IN SOUTHEASTERN WISCONSIN: 2000

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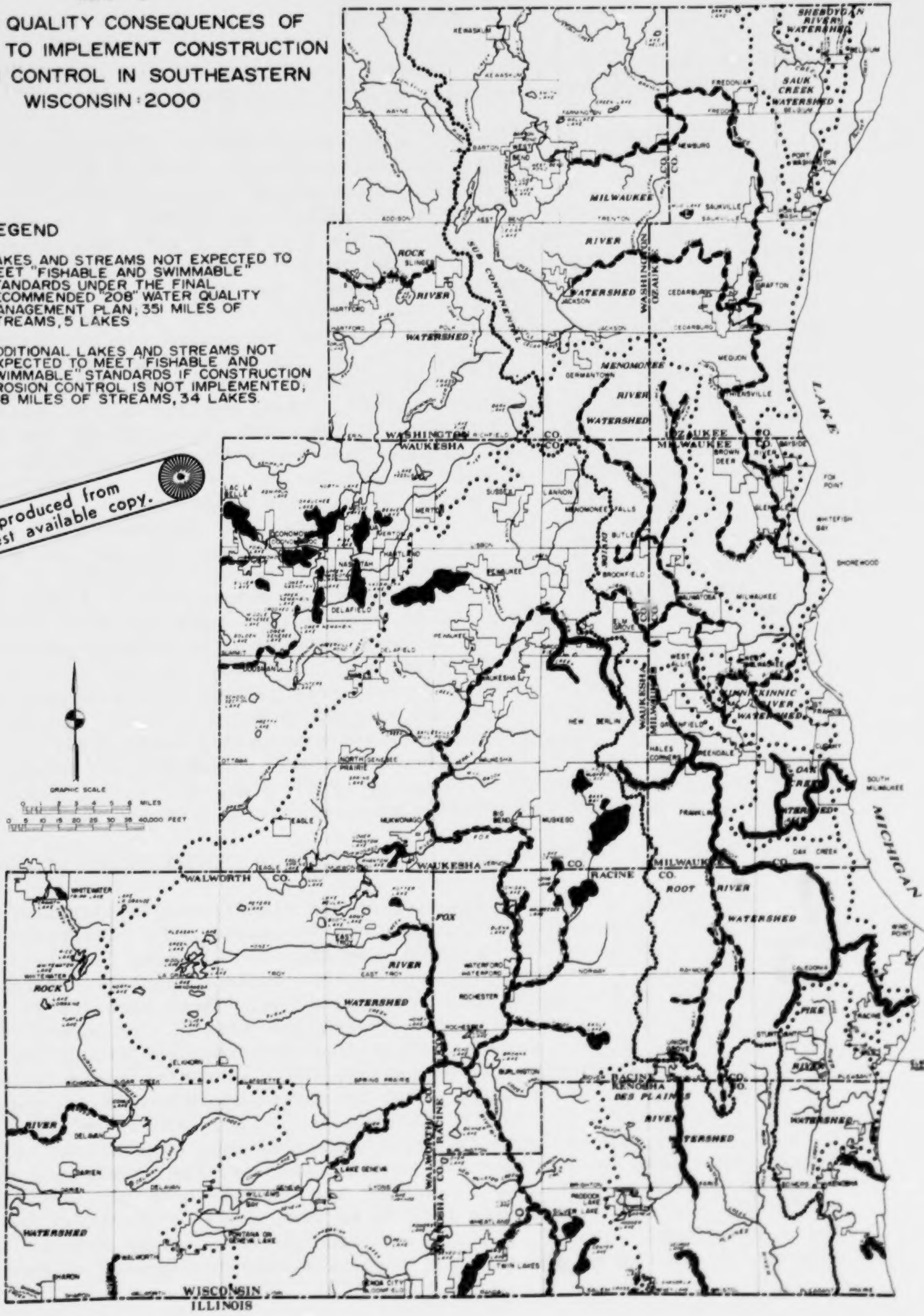
SHEBOYGAN RIVER WATERSHED
SAUK CREEK WATERSHED
MILWAUKEE RIVER WATERSHED
ROCK RIVER WATERSHED
SUB-CONTINENTAL DIVIDE
MENOMONEE RIVER WATERSHED
WASHINGTON CO.
WAUKESHA CO.
OZAUKEE CO.
MILWAUKEE CO.
KINNICKINNIC RIVER WATERSHED
OAK CREEK WATERSHED
WALWORTH CO.
RACINE CO.
KENOSHA CO.
FOX RIVER WATERSHED
ROOT RIVER WATERSHED
DES PLAINES RIVER WATERSHED
PIKE RIVER
LAKE MICHIGAN
WISCONSIN
ILLINOIS
GRAPHIC SCALE
0 1 2 3 4 5 6 MILES
0 5 10 15 20 25 30 35 40,000 FEET

LEGEND

LAKES AND STREAMS NOT EXPECTED TO MEET "FISHABLE AND SWIMMABLE" STANDARDS UNDER THE FINAL RECOMMENDED "208" WATER QUALITY MANAGEMENT PLAN; 351 MILES OF STREAMS, 5 LAKES

ADDITIONAL LAKES AND STREAMS NOT EXPECTED TO MEET "FISHABLE AND SWIMMABLE" STANDARDS IF CONSTRUCTION EROSION CONTROL IS NOT IMPLEMENTED; 108 MILES OF STREAMS, 34 LAKES technical assistance to the counties and municipalities. The University of Wisconsin-Extension Service--as well as the counties, municipalities and special purpose units of government such as inland lake rehabilitation districts--were recommended to provide educational and informational programs to promote public understanding and acceptance of the regulations.

The following conclusions concerning construction erosion control support the Regional Planning Commission's recommendation for regulatory control of construction site erosion.

1. Construction erosion is a significant source of water pollution, especially of phosphorus and sediment.
2. Although construction erosion control costs constitute a high proportion of the total cost of nonpoint source control, construction erosion control is a relatively cost-effective means of water pollution abatement.
3. Failure to control construction erosion will result in severe and widespread water quality degradation.
4. Construction erosion is a very visible and obvious pollution source. For this reason its control is more apt to be understood and accepted by the public, as evidenced by the development of some construction erosion control regulations by local units of government in the Region even prior to local adoption of the '208' plan.
5. The technology of construction erosion control, with regard to problem assessment, the availability of control techniques, and the reliability and effectiveness of these techniques, is better developed than most nonpoint source controls.

CONCLUSION

An article in Professional Builder magazine[4] stated that, as of 1978, excessive government regulation had added $1,500 to $2,500 to the price of a new home. Builders are, of course, subjected to a wide array of regulations. The information presented in this paper is intended to document that construction erosion control, where required to protect water quality, should not constitute excessive regulation, and that it is a logical and cost-effective measure for the protection of water resources. Construction generated pollutants have been quantified, cost-effective control techniques are available, and publicly acceptable institutional frameworks exist. Constructon erosion control is an important part of providing clean lakes and streams in southeastern Wisconsin.

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[1] Some studies have indicated that, with extensive pre-planning, construction erosion control can be achieved for from $220 to $400 per residential lot, or about $880 to $1,600 per acre in 1976 dollars. See C. A.

White, Best Management Practices for the Control of Erosion and Sedimentation Due to Urbanization of the Lake Tahoe Region of California, Presented at the International Symposium on Urban Storm Runoff, Lexington, Kentucky, July 23-26, 1979.

[2] U. S. Environmental Protection Agency, Comparative Costs of Erosion and Sediment Control, Construction Activities, EPA-430/9-73-016, 1973.

[3] International Joint Commission, International Reference Group on Great Lakes Pollution from Land Use Activities. Summary Pilot Watershed Report, Menomonee River Basin, Wisconsin, May, 1978.

[4] "Builder Skepticism on Fed Inflation War," Professional Builder, Vol. 43, No. 6, June, 1978, p. 34.

ABSTRACT

USE OF NATIVE VEGETATION IN URBAN AND SUBURBAN LANDSCAPES

Darrel G. Morrison
Department of Landscape Architecture
University of Wisconsin, Madison, WI

The concept of using native vegetation in groupings resembling natural communities provides an alternative to the "standard" landscape development which typically features individual trees and shrubs in a mowed lawn.

A diverse natural cover provides economic and aesthetic benefits, in addition to specific erosion-control and runoff-reduction functions. One study has shown, for example, runoff rate of zero from a 2.5" rainfall on a stand of native prairie vegetation, compared with 29 on bluegrass sod and 50 on bare ground.

The relatively large leaf surface per unit area in areas covered with prairie vegetation (e.g., a leaf surface area of 3 to 20 times the soil area) leads to greater water interception than in mowed lawns. Additionally, the deep and fibrous root systems that are characteristic of prairie grasses and forbs increase the permeability and infiltration rates. This combination of greater interception and infiltration of rainfall are responsible for the runoff reduction and the related erosion controlling capability of native plantings.

Case studies ranging from a suburban residential property to a 15-acre corporate headquarters and a 100-acre industrial site provide examples of native vegetation re-establishment techniques and some of the benefits that can result.

INNOVATIVE STORMWATER MANAGEMENT:
WHERE IS THE PROBLEM?

Paul C. Oscanyan, P.E.
Consulting Engineer
Rockville, Maryland

In today's construction industry, the need to protect the environment and the need to hold back spiraling costs have combined to create a strong demand for new or "innovative" approaches to both old and new problems.

Substantial progress has been made in many fields--solar energy, new materials for construction, and energy efficiency are but a few. Conspicuous by its absence from this list, however, is the relatively new field of stormwater management. It is not the purpose of this paper to introduce any brand-new techniques; rather, it will attempt to address the problem of why so young a field shows so little real innovation, and to suggest some means whereby innovation may be encouraged.

Innovative stormwater management may be defined as the creation and introduction of new techniques for the control of storm runoff, for the purpose of downstream environmental protection, retention of a usuable resource, or the protection of human life and property. For creation and introduction of new techniques to take place, there must be incentives to creative work; to ensure that only safe and effective techniques are introduced, certain constraints must be maintained.

Incentives

Among the strongest incentives to creative activity in any field are financial reward and professional recognition. The general effectiveness of the first of these is attested by the success of the patent system, which grants certain rights to the inventor of a new or useful combination of matter; the second, by the number of publications each month in a wide variety of technical and professional journals. Unfortunately, these incentives are largely absent in the case of stormwater management, for a number of reasons.

The construction industry, unlike most others, is unique in that it uses mass-produced materials but assembles them in fixed locations-- and each assembly takes place at a different location. Each construction site differs from all other sites; no two are identical, though all sites have some features in common. For this reason, no two stormwater management structures will be completely identical even if they are built from the same materials. Since this is the case, the basic premise of the patent system, that of technological portability, is to all intents and purposes absent, and thus the primary system for ensuring financial rewards for innovation is inoperative. Without the prospect

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of financial reward, it becomes difficult for any profit-making organization (such as a building or consulting engineering firm) to justify the heavy expense of a research project, no matter how promising it might be in terms of technological improvement.

The construction industry also differs from others in that it is sharply divided into segments which not only perform very different functions, but which are often in an adversary relationship. These segments are the public, which creates the market for construction; the builders, who arrange for the financing, design and sale of projects to satisfy that market; the engineers and architects who design those projects; the contractor who does the actual construction; and the public agencies which must ensure that both design and construction protect the public health and safety. In addition, there are a variety of organizations such as universities and research laboratories from which there are occasional infusions of new techniques.

Of all of the above segments of this industry, only the last, the "academic," segment, feels any real pressure to gain professional recognition through the discovery and publication of new techniques. This is not to say that this segment is the only source of new technology; although consulting engineers do from time to time publish technical papers, even a brief review of any professional journal will show that the majority of the papers derive from academic sources.

Constraints

Each segment of this industry is subject to a variety of constraints, all of which tend to reduce the rate at which new technologies are introduced. Most of these constraints have been deliberately introduced in order to protect the public safety and health, but all contribute to the adversary relationship referred to earlier.

The public, which ultimately finances the entire construction industry, is faced with rising costs for everthing it purchases--food, clothing, housing, and so on. Even, perhaps especially, in an age of high inflation rates, there are limits to how much the public can spend on construction. This, in turn, limits the ability of the builder to recoup his own costs, and thus provides him with a strong disincentive to spend the extra money which is required to develop and implement a new technique, even though such a technique might reduce long-term costs.

In addition to the time and cost constraints imposed by the builder's funding and construction schedule, the consulting engineer is bound both by law and his Code of Ethics to provide designs which will protect the public health and safety, and which will conform to generally accepted standards. The engineer who deviates from these rules does so at his peril. Should his design fail either structurally or functionally, he may be liable under both civil and criminal law, regardless of whether or not his design was approved by a public agency with review authority.

The contractor is limited both by his finances and his contract with the builder. He must build only what the engineer's design calls for, and may only suggest changes. Unless these changes are approved by the builder, the engineer and the public agency having jurisdiction, he assumes not only the cost of any changes he makes, but liability similar to that described for the engineer.

Public agencies are charged by law with the protection of the public health and safety. For this reason, if an engineer submits a request for approval of a design which deviates from standard practice, the agency will rightly require careful documentation that the proposed deviation will, in fact, adequately protect the public. Again, should the agency approve an insufficiently documented innovative design, it lays itself open to liabilities.

Conflicts

Stormwater management, innovative or not, is still more of an art than a science. Designs are based on probabilities and estimates--the probability of a storm of a certain magnitude, estimates of how much of the rainfall will become runoff, estimates of roughness coefficients, and so on--many of which are based on experience and empirical formulas. Such design methods do not lend themselves to ready analysis, or synthesis with mathematically valid modelling; they do have the advantage of being relatively rapid in application, and do not require sophisticated data or techniques. Academically derived techniqes, on the other hand, tend to be highly sophisticated in their mathematical approach, to require large data bases, and to be both slow and expensive in application.

This contrast in approaches to a common problem has brought about a schism between the consulting engineer and the research scientist, precisely the opposite of what has happened in most other industries, where laboratory discoveries move rapidly into place on the production line.

Other conflicts arise when the engineer wishes to attempt an innovative design. First, there is the problem of obtaining the builder's approval; unless the engineer can give the builder fairly good assurance that there will be no increase in cost, such approval will rarely be forthcoming. Secondly, there is the hurdle of agency approval to overcome; even if the cost savings to the builder are potentially great, the time required for agency approval may exceed the time that the builder can afford.

Moving Forward

From the foregoing, it might seem that there is no way to increase what might be termed the "rate of innovation." This is far from being the case. The present mechanisms of the design and review process were not originally inteded to encourage the development of new technologies; nonetheless, innovation does take place, however slowly. It is, therefore, highly probable that these mechanisms can be improved or adjusted to allow more rapid change.

The present mechanisms operate on a principle which electronic engineers refer to as "negative feedback"; in other words, the more radical a proposed change is, the greater is the resistance to that change. Due to the considerations of public health and safety, this is in fact an absolute necessity; nonetheless, if the rate of change is not to be slowed down too much, some "positive feedback" is required. The problem is therefore one of finding some means of safely introducing this condition into the present mechanisms.

This can be accomplished in a number of ways, all similar yet independent of each other.

There must be more communication between contractors and engineers. Too often, the necessary separation between design and construction prevents each one from learning the other's problems and benefiting from his experience.

There must be open lines of communication from builders, contractors, and engineers to the research scientists. Unless the scientist knows what problems actually need to be solved, he is reduced to finding his own problems--and those problems may not be nearly as pressing as others. Furthermore, unless he receives data from the field, he is denied the benefit of the experience gained by those involved in practical applications.

There must be an acceptance on the part of the engineer that he is central to the problem. It is the engineer who must take a theory and translate it into a design; it is the engineer who must be prepared to explain to the public and the public agency why a certain procedure should or should not be followed. He must, therefore, keep in close touch with both agencies and the researchers.

The researcher must remain aware that the objective of his research is not merely to advance theoretical knowledge, but to communicate his knowledge to as wide an audience as possible, in a form useful to that audience. In the same vein, it is incumbent on him to draw on whatever pragmatic knowledge is available, from whatever source, and thus to be aware of the problems of the builder, the engineer and the agency.

The agency, too, must be sensitive to the problems of the builder, the engineer and the contractor; a lapse in communications too often results in excessive regulation and inadequate enforcement.

Conclusion

Throughout this paper, liberal use has been made of impersonal terms: the public, the builder, the engineer, the agency, the researcher.

Innovation can be encouraged by groups such as these, but the actual development and implementation of new techniques will always come about through the actions of individual people working in concert.

INVESTIGATION OF CONCRETE GRID PAVEMENTS

Gary E. Day, Assistant Professor of Architecture
College of Architecture and Urban Studies
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

Summary

The following research involves laboratory simulation and testing of typically installed concrete grid pavements. Five pavements exhibiting different physical characteristics were subjected to rainfall in order to collect runoff data. Coefficients of runoff and lag times are derived based on the following variables: (1) subgrade soil, (2) slope, (3) rainfall intensity, and (4) rainfall duration. The tentative runoff coefficients can provide the basis for design and implementation of the pavements as an alternative on-site technology within an overall, stormwater management scheme. Future directions for investigations not directly related to hydrological characteristics are also included.

Background

Current directions in stormwater management emphasize the maintenance of pre-development runoff levels through on-site controls. Where traditional practices have utilized curbs and gutters to quickly convey stormwater to storm sewers, new approaches use roadside drainage swales to slow the velocity of drainage and allow for infiltration. New techniques emphasize the use of natural drainage systems with their low-velocity flow characteristics, and take advantage of opportunities for infiltration and groundwater recharge. Conventionally, parking lots have been designed to drain quickly. New goals also encourage the absorption or detention of stormwater in parking lots and on-street parking. Stormwater can be detained and allowed to either infiltrate into the soil or be slowly released after the storm event.

Concrete grid pavements have potential as a management practice for maintaining pre-development runoff levels by allowing for infiltration and groundwater recharge. These pavements can decrease the quantity of peak flow and increase lag time. Furthermore, this would minimize stream bank erosion and sedimentation due to increased runoff loads during and after storm events, thereby improving water quality. Concrete grid pavements have been used extensively in Europe and are presently available from manufacturers throughout the United States. On a properly compacted subgrade and properly designed and installed subbase, these pavements can support extremely heavy vehicular loads. Unfortunately, very little information is available concerning their hydrological characteristics either from the manufacturers or in the form of research data. We believe this is a key factor which inhibits the use of these pavements as an alternative technology for the reduction of stormwater runoff.

Equipment

Pavements were tested under a controlled setting at the Environmental Systems Laboratories of the College of Architecture. The testing apparatus contained three major elements; the rain simulator, the testing bins and the water collection system.

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Rain Simulator. The rain supply was provided by a rain simulator built and designed by the University's Laboratory Support Services. The rain simulator consisted of a single rotating irrigation nozzle selected because it produced a drop size and distribution similar to that of natural rainfall. The nozzle was rotated by a 1/15 horsepower motor geared at 2 rpm. The nozzle was situated approximately 14 feet above the pavement surface. Water pressure was governed by a pressure regulator and was displayed on a pressure gauge.

Testing Bins. The pavements were installed in three bins. Each bin was 6 feet long, 4 feet wide, and 3 feet deep. Their floors were constructed with 3/4 inch plywood glued to 2" by 10" joists, 6" on center. These platforms rested on two level steel I beams. The sides of the bins were constructed with 3/4 inch plywood glued to 2" by 4" studs, 9" on center. One side wall of each bin was removable to facilitate material extraction. The bins were waterproofed with 6 mil polyethelene film. Corrugated sheet metal was placed at the bottom of each bin to provide protection for the underlying waterproof plastic film. An inch and a half of cleaned gravel was spread over the corrugated sheet metal to facilitate subsurface drainage. Eleven to fourteen inches of soil were compacted manually with tampers in lifts of three inches. Soil compaction was tested with a hand-held penetrometer to document the level of compaction reached and assure uniformity. A minimum compressive strength of 3.5 tons per square foot was attained. Six inches of cleaned gravel were installed over each "subgrade." Aggregate size of this gravel ranged from 1" to 1/5". The depth of this "subbase" is typical for the pavements tested. Two inches of sand were added on top of the gravel. This sand was compacted and leveled to provide an adequate bearing surface for the pavers. The pavers were then installed. Voids were filled with top soil and sod. Turfgrass selection was made in consultation with Dr. Richard E. Schmidt of the University's Turfgrass Research Center. Mixtures of Kentucky Blue Grass sod were selected because of its durability under traffic and drought. See Figure 1 for illustrations of the test bins.

Water Collection System. The collection system gathered water which flowed off the surface of the pavers and percolated through the soil. The water flowed into covered channels and through hoses to calibrated tanks. From these tanks periodic measurements could be taken. Each test bin had two tanks: one to collect surface runoff and one for subsurface drainage. Figure 2 illustrates the water collection system for the bins. Pavement slopes were adjusted by lifting the bins at one end with hoists. The pavements were tested at three slope settings: 2%, 4%, and 7%. These slopes represent the range found in typical parking lots.

Soils. Soils used in this investigation were obtained from University land close to the laboratory. The following soils were chosen for "subgrade": Bin #1, B horizon of Greensdale Silt Loam; Bin #2, B horizon of Groseclose, and Bin #3, C horizon of Frederick Silt Loam. For the purpose of this discussion we have named the Greensdale a "loose" soil, the Groseclose a "moderate" soil, and the Frederick Loam a "tight" soil. These three soils offered the greatest range of permeability values indigenous to this area and within close proximity to the laboratory. See Figure 3 for a comparison of hydraulic conductivity and permeability classes of each soil derived from soil tests.

Bulk Density. Soil bulk density is the ratio of mass to the bulk or volume of a soil sample. The maximum bulk densities were determined by using the Harvard Miniature Compaction Apparatus.

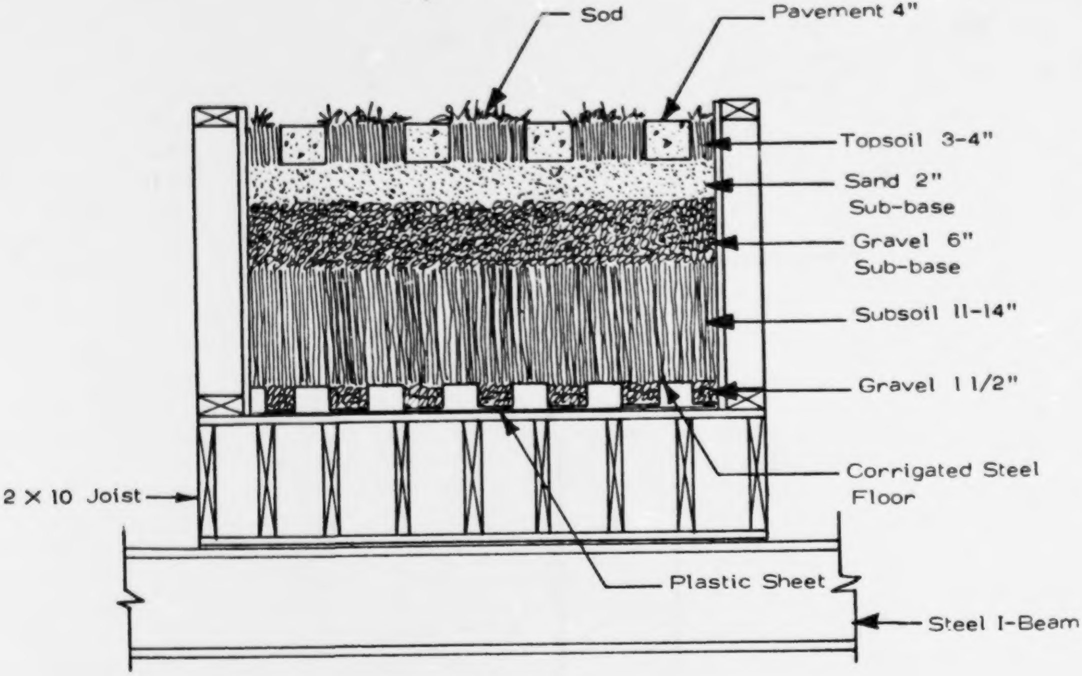

Sod
Pavement 4"
Topsoil 3-4"
Sand 2"
Sub-base
Gravel 6"
Sub-base
Subsoil 11-14"
Gravel 1 1/2"
Corrigated Steel
Floor
2 X 10 Joist
Plastic Sheet
Steel I-Beam

Figure 1 - Typical Test Bin Cross-section

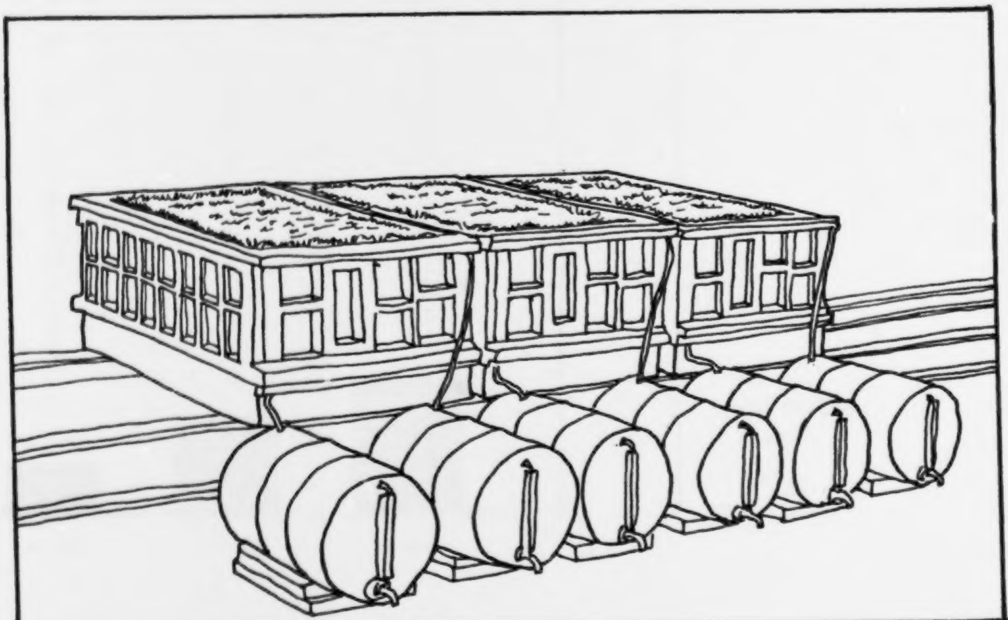


Figure 2 - Three Test Bins

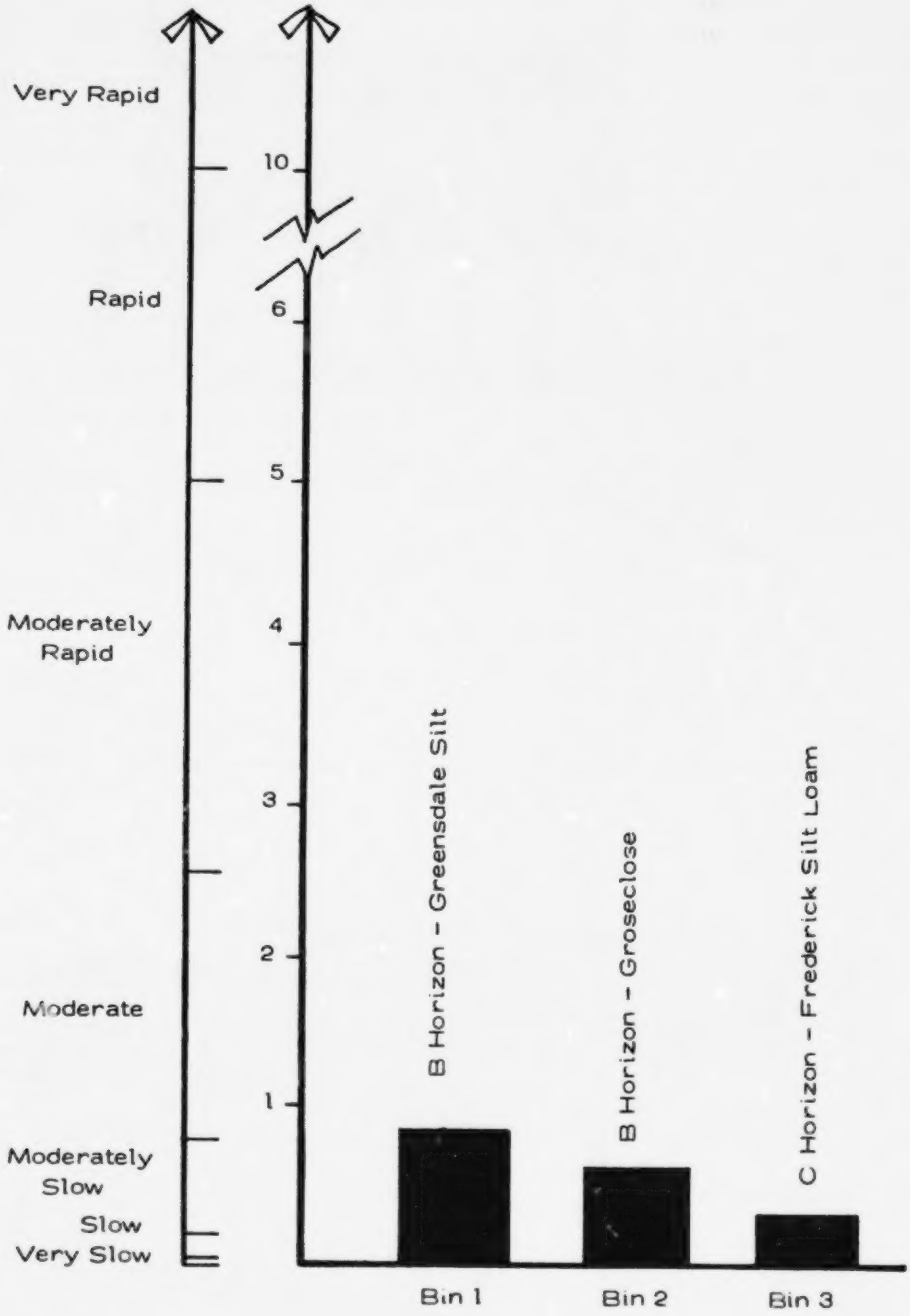


Figure 3 - Comparison of Hydraulic Conductivities (in./hr.) of Soils to Permeability Classes

Pavement manufacturers generally specify a compacted subgrade from 85 percent to 95 percent of the maximum dry density. Moisture content must be in a range of plus 4 percent or minus 2 percent of the optimum moisture content. Soils used in test bins were compacted to within the following percentages of their maximum dry bulk densities and within the following range of optimum moisture: Test Bin #1, Greensdale Silt, 83.2% maximum density at -2% optimum moisture; Test Bin #2, Groseclose, 78.8% maximum density at optimum moisture; and Test Bin #3, Frederick Silt Loam, 82% maximum density at +1.5% optimum moisture.

Classification of Pavers. The five different paver types classified into two categories, lattice and castellated, as shown in Figure 4. Table 1 specifies the dimensions and weight of each pavement.

Table 1

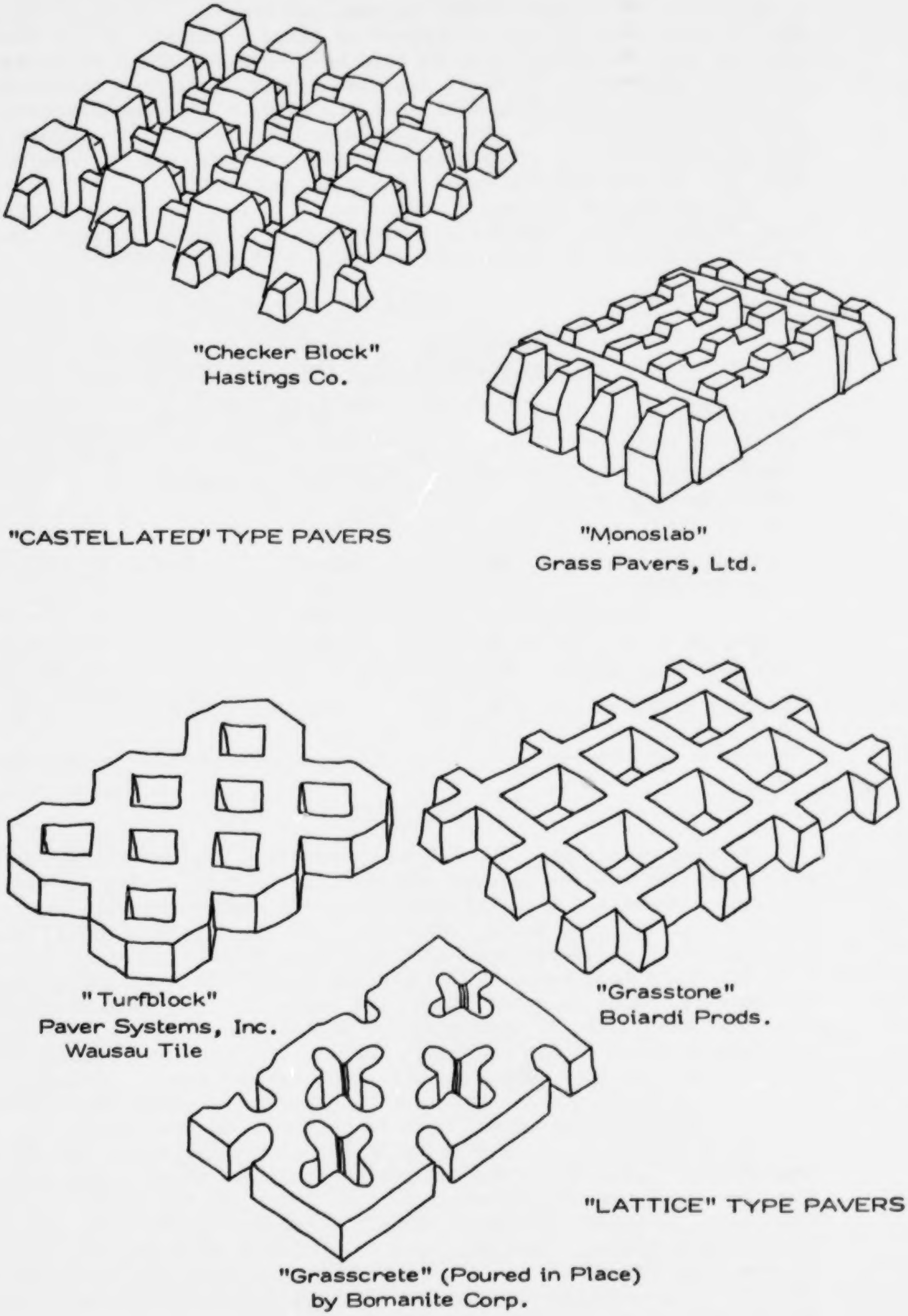
Paver	% Open Area at Bottom	Weight (lbs)	Thickness inches	Length/Width inches
GRASSTONE Bolardi Prods.	34	59	3.625	23/17.25
TURF BLOCK Paver Systems, Inc. Wausau Tile	40	63	3.125	23.5/15/.5
GRASSCRETE Bomanite Corp.	30	Poured in Place	4 & 6	24/24
MONOSLAB Grass Pavers, Ldt.	15	82	4.5	23.5/15.5
CHECKER BLOCK Hastings Co.	25	84	3.75	24/24

Procedure

Testing Procedure. There were three tests performed with each paver type under observation through one testing cycle (described in the next section). Monoslab, a castellated type paver comprised test one. Turf-block, a lattice type paver, comprised test two. Both of these pavers were tested in all three bins with the three subsoil types.

Our third test consisted of placing one of the three remaining paving systems--Grasstone, Checker Block, and Grasscrete--in each of the bins. Grasstone was in bin #1 (loose soil), Grasscrete in bin #2 (moderate soil) and Checker Block in bin #3 (tight soil). Limited funds did not allow us to test each of these pavers on all three subsoil types. In spite of these constraints, we used the three remaining pavers to check the difference in the performance of the pavers used in test one and test two.

Testing Cycles. A testing cycle for each paver consisted of a two-hour rain followed by a two-hour drain period for three consecutive days. The rain simulator was activated for two hours and the surface runoff recorded. Subsurface drainage was monitored for another two hours after the rainfall period. The bins were then allowed to drain for 20 hours between each day of tests. During the first evening the slope was set at 7%. Prior to starting the second and third evenings of tests, the slope was lowered to 4% and 2% respectively.



"Checker Block"
Hastings Co.

"Monoslab"
Grass Pavers, Ltd.

"CASTELLATED" TYPE PAVERS

"Turfblock"
Paver Systems, Inc.
Wausau Tile

"Grasstone"
Boiardi Prods.

"Grasscrete" (Poured in Place)
by Bomanite Corp.

"LATTICE" TYPE PAVERS

Figure 4

The day before the three test cycles the bins were saturated with rain at identical durations and slopes. Surface runoff and subsurface drainage were monitored to be sure that each bin was 100% saturated. The bins were allowed to drain 20 hours before commencing the next day's tests. This was done to insure that each subsoil had an equivalent moisture content before gathering runoff test data. Surface runoff in gallons was recorded at 5 minute intervals during the rain periods. Subsurface drainage was recorded every 15 minutes during both the two-hour rain and two-hour drain periods.

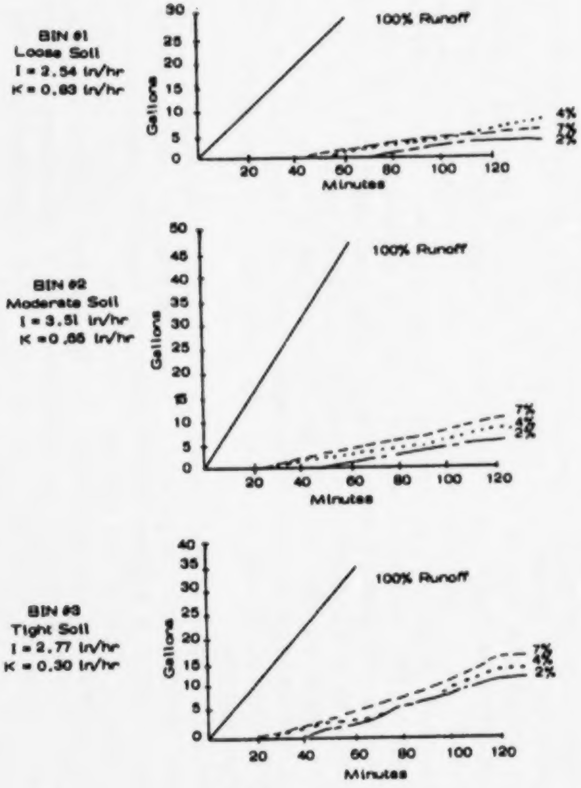
Results

Results from Tests 1, 2, and 3 are displayed in Figure 5. The performance curves at each slope setting are referenced against the 100% runoff curve for each bin. These curves show the total volume (gallons) of surface runoff plotted against time (duration of rainfall). Notice that the difference in lag time for each bin varies.

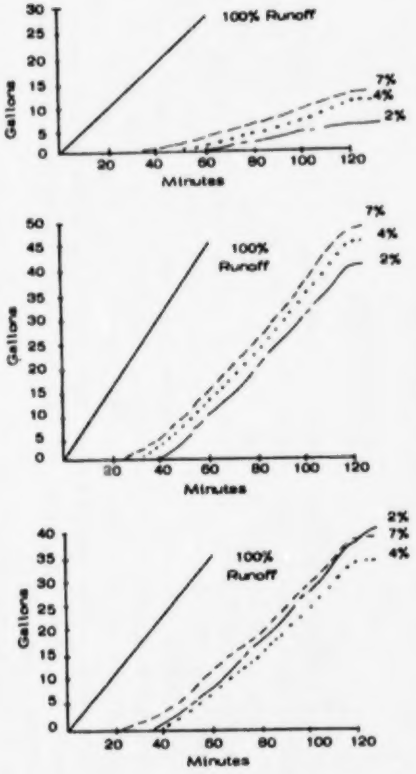
Coefficients of runoff were developed from the performance curves which are displayed in Table 2. Coefficients were developed for storm durations of 30, 60, 90 and 120 minutes.

Conclusions

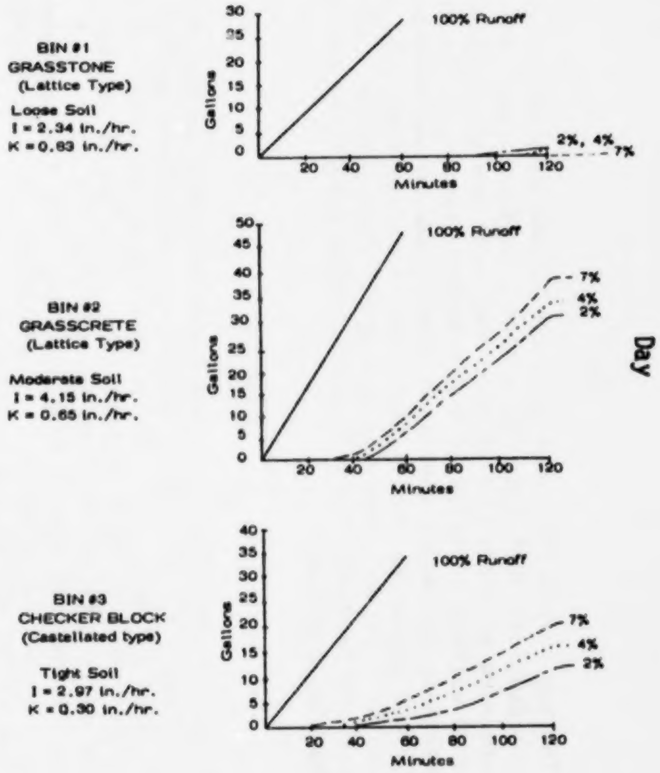
1. Before commencing the tests we hypothesized that under the same rainfall, soil, and slope conditions, the paver with the highest percent of open area at the bottom should have the least amount of surface runoff. Turfblock, however, the paver with the highest percent of open area on the bottom, does not have the lowest runoff coefficients (note Table 2). In fact, Monoslab, with the lowest percent of bottom open area (15%), yielded lower coefficients when tested under similar conditions to Turfblock. Therefore, our hypothesis is challenged by this data. The ability of the paver to absorb and detain rainwater tends to be a function of its surface geometry, not the percent of bottom open area.
2. An increase in slope (up to 7%) increases the coefficient of runoff regardless of paver type, subsoil type, or rainfall intensity. The greater the slope, the greater the runoff. Is there a "critical slope" at which the runoff coefficients approach that of asphalt or solid concrete paving? Is that critical slope different for each paver type? Is it different for each subsoil type on which the paver is placed? A potential area of investigation is in studying the relationship of the orientation (in plan) of a paver to a given slope. The five pavers tested were placed longitudinally in the bins. Would there be a difference in runoff if these pavers were placed askew at a 45° angle to the slope? Would there be more or less of a difference in percentage of runoff between the two categories of pavers? The difference, if one exists, may lead to more sensitive and effective application.
3. Subsoil type, as expressed by hydraulic conductivity, has an effect on the coefficient of runoff. Lower hydraulic conductivity of the subsoil yields a higher coefficient of runoff, especially on steeper slopes. This is consistent unless the rainfall intensity approximates the hydraulic conductivity of the subsoil. When this occurs, little or no surface runoff is produced. Note Grasstone in Test 3, Table 2. The hydraulic conductivity of the subsoil approaches the rainfall intensity on this bin; hence, no runoff.



Test 1: Runoff from MONOSLAB (Castellated type)
I = Rainfall Intensity
K = Hydraulic Conductivity of Subsoil



Test 2: Runoff from TURFBLOCK (lattice type)



Test 3: Runoff from Pavers
(Note Lattice and Castellated Types)

Figure 5 - Test Results

RUNOFF COEFFICIENTS FOR CONCRETE GRID PAVEMENTS

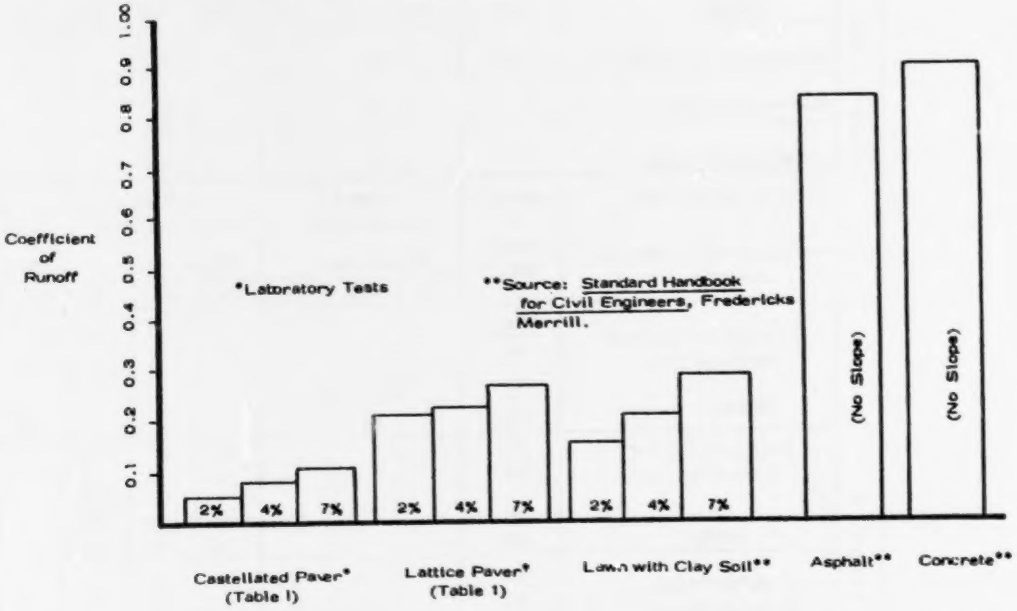
	PAVING SYSTEM (Percent of Open Bottom Area)	Mins. of Rain-fall	BIN #1 Loose Soil Slope at:			BIN #2 Moderate Soil Slope at:			BIN #3 Tight Soil Slope at:		
			2%	4%	7%	2%	4%	7%	2%	4%	7%
TEST 1	MONOSLAB Grass Pavers, Ltd. (15%)	30	0	0	0	0	.09	.09	0	.09	.09
		60	0	.05	.05	.04	.06	.09	.09	.09	.12
		90	.05	.08	.09	.06	.07	.10	.15	.15	.20
		120	.07	.09	.10	.07	.09	.11	.17	.19	.23
TEST 2	TURFBLOCK Paver Systems, Inc. Wausau Tile (40%)	30	0	0	0	0	.01	.05	0	0	.10
		60	.01	.03	.09	.21	.28	.32	.23	.26	.36
		90	.06	.09	.16	.37	.37	.42	.37	.43	.45
		120	.09	.17	.20	.43	.48	.51	.48	.54	.56
TEST 1 &2	Hydraulic Conductivity In./hr.		0.83			0.65			0.30		
	Rainfall Intensity In./hr.		2.54			3.51			2.77		
	Gallons/Minute		0.47			0.80			0.55		

	PAVING SYSTEM (Percent of Open Bottom Area)	Mins. of Rain-fall	BIN #1 Loose Soil Slope at:			BIN #2 Moderate Soil Slope at:			BIN #3 Tight Soil Slope at:		
			2%	4%	7%	2%	4%	7%	2%	4%	7%
TEST 3	CHECKER BLOCK Hastings Co. (25%)	30							0	0	.09
		60							.03	.07	.12
		90							.10	.16	.22
		120							.16	.21	.27
	GRASSCRETE Bomanite Corp. (30%)	30				.02	0	.02			
		60				.13	.15	.18			
		90				.23	.25	.28			
		120				.29	.31	.35			
	GRASSTONE Boiardi Prods. (34%)	30	0	0	0						
		60	0	0	0						
		90	0	0	0						
		120	.01	.01	0						
TEST 3	Hydraulic Conductivity In./hr.		0.83			0.65			0.30		
	Rainfall Intensity In./hr.		2.34			4.15			2.97		
	Gallons/Minute		0.48			0.88			0.60		

Table 2

Future Directions

Beyond Hydrological Research. In addition to the ability to reduce runoff, the pavements should have the following potential environmental benefits: (a) nonpoint pollution reduction, (b) glare reduction, (c) sound absorption, and (d) microclimatic temperature reduction. These aspects are favorable by-products of the pavement's function of runoff reduction. It is possible to also consider redesigning the configuration of the pavements to achieve better ergonomic aspects. Improvements could produce a surface compatible with walking, bicycling and use by handicapped adults or children. Figure 6 indicates that the runoff coefficients derived in this investigation are sufficiently lower than standard asphalt and concrete pavements. In view of this observation, these pavements could actually be less expensive to install than conventional pavements when a corresponding reduction of storm sewer pipe sizes and lengths are taken into account.



*Latoratory Tests

**Source: Standard Handbook for Civil Engineers, Fredericks Merrill.

Figure 6 - Comparison of Concrete Grid Pavements to Other Urban Surfaces

References

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EROSION AND SEDIMENT CONTROL REGULATORY LAWS -- EVOLUTION AND CURRENT STATUS

Mary M. Garner
Legal Consultant
National Association of Conservation Districts

HISTORICAL BACKGROUND

From our nation's earliest days we have had the problem of exhausting our land resources by over use and improper use. The problem became more severe year by year, but it was not until the early 1930's, when mounting soil erosion, floods, and sky-blackening dust storms swept across the nation, that the public was aroused to an awareness of the seriousness of the problem. This brought about enactment by Congress of the Soil Conservation Act of 1935 1/ which established an erosion and sediment control policy for the Nation.

Soil Conservation Act of 1935

The 1935 Act provided for the creation of the Soil Conservation Service in the U.S. Department of Agriculture to develop and carry out a continuing program of soil and water conservation. Through this agency the Federal government began an intensive program of technical and financial assistance to promote erosion and sediment control. However, it was soon recognized that to achieve the extended application of this program that was needed to reverse the steady and increasing loss of soils by wind and water, it was necessary to reach and obtain the involvement of private citizens since they owned some three-fourths of all the land in the contiguous 48 states. To achieve this end, the Secretary of Agriculture adopted the policy that all erosion work on private lands would, after July 1, 1937, be undertaken by the Soil Conservation Service only through legally constituted soil conservation associations. A provision for the establishment of such associations was included in the Standard State Soil Conservation Districts Law furnished by the President in 1936 to all state governors as a guide to enactment of appropriate legislation that would enable states to participate in the soil and water conservation program.

State Conservation Districts Law

Every state, Puerto Rico, and the Virgin Islands passed such legislation based on the Standard Act, and formulation of districts began immediately and continued steadily until now nearly 3,000 districts cover over over 99 per cent of the Nation. Under these state laws, conservation districts are established as local units of government, with a governing body composed of elected or appointed local citizens, who are responsible for conservation work within the district's boundaries. Although the state laws vary in some respects, their purposes are the same: to identify land, water, and related resource problems, to develop programs to solve them, and to enlist and coordinate help from all available public and private sources that can contribute to accomplishing district goals.

Neither the Federal law nor most state conservation districts laws restricted the program to rural lands. However, in the beginning, conservation districts worked mainly with farmers and ranchers and district boundaries usually did not include urban areas. Although farmers and ranchers are still the principal cooperators since they control most of the land, in more recent times, especially in rapidly expanding areas, districts have extended their boundaries, as well as their programs and services, to other lands and landowners. Many states have followed the lead of Louisiana, which amended its districts law in 1966[2] to include all lands in the state within districts. Others have included urban areas by following the procedures in the law for addition of territory. Counties, towns, suburbs and businesses now cooperate with districts just as rural landowners do.

When districts began operations, their major task was control of soil erosion caused by runoff water and by wind. However, over the years the work of districts has expanded to cover the entire broad spectrum of conservation and natural resource development. Today's district programs include not only the critical work needed to conserve prime food and fiber producing agricultural lands, but also the application of conservation technology and the experience and expertise of districts to problems of urban expansion, waste disposal, highway and utility planning and maintenance, building construction, recreational facilities, and beautification.

DISTRICTS REGULATORY AUTHORITY

Historical Recognition of Need

The Standard act distributed to the states in 1936 contemplated the need for regulatory controls in its provisions for land use regulations. Most state district enabling laws of the 1930's and 1940's included such provisions. However, districts have from their beginning conducted their programs on a voluntary basis, using education, technical assistance, and cost sharing rather than mandatory controls. Although the regulatory authority was seldom used, and some states dropped the provisions from their laws, more than half the states still retain the authority.[3]

Renewed Interest in Regulation

In recent years several states have shown an interest in using the land use regulatory authority in their districts laws to respond to the increasing public concern for the environment and, more specifically, to meet the demands for non-point source pollution control. New Jersey's Camden County Soil Conservation District relied on such authority in issuing erosion and sediment control regulations on February 24, 1974. The regulations were a forerunner of the erosion and sediment control law adopted by New Jersey in 1975. Since that law applies statewide, further action by individual districts was unnecessary. The Lewis and Clark Conservation District in Montana, by referendum in June, 1977, adopted a soil erosion and sediment control ordinance under the authority of the Montana Conservation Districts Law.

In Wisconsin, after attempts to adopt regulations were unsuccessful because of failure to obtain the required two-thirds majority in a referendum, the law was amended in 1971 to permit adoption of regulations by a simple majority and to broaden the law's application to soil and water conservation districts wishing to adopt land use regulations for sediment control. Such an ordinance for the Vernon County Soil and Water Conservation District was approved by referendum in the November, 1976, general election and adopted by the Vernon County Board of Supervisors on June 21, 1977. Apparently the cumbersome procedures and length of time involved in following this course has discouraged other districts from similar action.

District Cooperation with Regulatory Agencies

Many districts, while not exercising regulatory authority directly, have for years provided counties and other local governments with technical assistance in the development of erosion and sediment control requirements for land subdivision, zoning, building, and other ordinances relating to land-disturbing activities. For example, since 1965, ordinances have been enacted in the counties of Montgomery (1967), Howard (1970), and Washington (1977) in Maryland; Otsego County in Virginia (1966, 1970); and Buffalo County in Wisconsin (1965). Most of these ordinances provide that a permit for any earth-moving activity may be issued only when there is a plan approved by the local conservation district for the control of erosion and sedimentation.

Recognition of Need for Stronger Control Programs

In the late 1960's and 1970's, a number of states, aware of the growing seriousness of erosion and sedimentation problems, enacted new erosion and sediment control legislation. Maryland amended its Water

Resources Law in 1970[4] to require approval by the appropriate soil conservation district of erosion and sediment control plans prior to the issuance of building permits and to require counties to enact ordinances for implementing this provision of the law. In 1971 Iowa became the first state to require its soil conservation districts to establish permissible soil loss limits.[5] That same year South Carolina[6] and the Virgin Islands[7] passed laws authorizing local governments to require, by ordinance, sediment control measures approved by conservation districts.

New impetus to the growing concern among states for the problem of erosion, sedimentation, and related pollution arose out of the requirements of Section 208 of the Federal Water Pollution Control Act of 1972 which requires a program for the control of point and nonpoint sources of pollution as part of state and areawide water quality management plans. This law has caused districts to reevaluate the adequacy of a purely voluntary program and to consider their role in a regulatory program.

MODEL EROSION AND SEDIMENT CONTROL ACT

Development of Model Act

The increased recognition of the need to strengthen erosion and sediment control programs brought about development of the Model State Act for Soil Erosion and Sediment Control. The model act was prepared by a task force established to respond to a very real need which became apparent at the Workshop on Soil Erosion that met in conjunction with NACD's Special Committee on District Outlook in March, 1972, under the auspices of the National Symposium on State Environmental Legislation in Washington, D.C. The task force was composed of representatives from the Council of State Governments, the Environmental Protection Agency, the US Department of Agricutlure, and the National Association of Conservation Districts. The Council of State Governments included the model act in its 1973 Suggested State Legislation.[8]

The principal provisions of the model law, which is in the form of an amendment to existing conservation districts laws, include: establishment of a comprehensive state erosion and sediment control program and adoption of statewide guidelines, including conservation standards for the control of erosion and sediment resulting from land-disturbing activities; establishment of district programs and conservation standards consistent with state programs and guidelines; prohibition of land-disturbing activities, with the exemption of certain minor land disturbing activities, unless conducted in accordance with approved soil erosion and sediment control plans; use of existing regulatory mechanisms, such as building, grading, and other permits applicable to land-disturbing activities, to implement erosion and sediment control plan requirements; inspection, monitoring, and reporting requirements; and penalties, injunctions, and other enforcement provisions.

Response to the Model Act

The response by the states to the Model Act reflected the keen interest that had developed in erosion and sediment problems. From late 1972 through early 1975, NACD held 40 state sediment control conferences to increase awareness of erosion and sediment control problems, report on existing and proposed mandatory programs in this field, explain the provisions of the model act, and encourage needed legislative and administrative action to deal with the problem. The "Report on State Sediment Control Institutes Program," published in April, 1975[9], found that the conferences had enhanced recognition of the sediment problem -- the nation's most prevalent pollutant by volume -- and gained wider acceptance of the need for accelerated action to combat the problem by local, state, and federal agencies and private organizations. According to the report, the conferences had also influenced the enactment of several new state laws establishing regulatory programs, the drafting of 15 new laws for introduction in state legislatures, and the modification of several pending legislative proposals.

Model Act Modifications - Alternative Provisions

The seminars revealed areas in which there was considerable variation in the requirements of the several states and, therefore, a need for provisions in addition to, or other than, those set out in the model act. To meet this need, new provisions were drafted by NACD as suggested alternatives. The most significant of these alternative provisions are:

(1) Definations of "Soil Erosion", "Sediment", "Sediment related pollutants", and "Enduring practices".

(2) More specific provision for application of the law to water quality and, among other things, the reduction of drainage from stormwater runoff and retardation of nonpoint pollution from sediment and related pollutants.

(3) More specific provisions for the application of the erosion and sediment control provisions to agricultural and silvicultural lands.

(4) Clarification of the provisions requiring that erosion and sediment control plans approved by a conservation district

must be submitted with an application for a grading, building, or other permit for a land disturbing activity.

(5) Provision that local governmental units, such as counties and muncipalities may issue ordinances requiring local programs consistant with the erosion and sediment control act.

(6) Authorization for the State agency to make grants of funds, including, but not limited to, cost-sharing assistance for enduring practices.

(7) Provision for a procedure for complaints by persons claiming damage from land-disturbing activities.

NEW LEGISLATION

Twenty states, the District of Columbia and the Virgin Islands have now adopted legislation to strengthen to some extent their erosion and sediment control programs. These include Delaware, Georgia, Hawaii, Illinois, Iowa, Maine, Maryland, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, South Dakota, and Virginia. A list of citations to these laws and a summary of their principal provisions are attached as Appendix A. The citations will apply to any further references herein to such laws.

Some recent erosion and sediment control laws, such as those in Delaware, the District of Columbia, Michigan, New Jersey, and Virginia, have adopted, with varying modifications, many of the provisions of the model act. In other states, erosion and sediment control provisons have been included in broader legislation, such as Montana's Natural Streambed and Land Preservation Act of 1975, and Pennsylvania's Clean Streams Law, under which erosion and sediment control regulations were promulgated. In Maine, the provisions are found in the requirements of the Water Pollution Abatement Licensing Program. Nevada's recent law providing for control of water pollution from diffuse sources is included in its Water Pollution Control Law. Although districts are not specifically named in the law, it is contemplated that district expertise will be used in carrying it out.

Although the primary purpose of these laws is directed toward the same ends -- the prevention and control of erosion and sediment damages and the improvement of water quality -- their methods and approaches to the achievement of these ends vary.

Methods of Prevention and Control

Conservation Plans. An approved erosion and sediment control plan is required for land-disturbing activities in Delaware, the District of Columbia, Georgia, Maryland, Michigan, Montana, New Jersey, New York, North Carolina, Ohio, South Carolina, Virginia, and the Virgin Islands. Pennsylvania requires that an acceptable plan be available at the site of the activity, and South Dakota requires an approved plan where the district determines that an agricultural land-disturbing activity is violating adopted standards. Nevada requires that the initial design of a project must provide measures to prevent pollution. The New Hampshire law relating to dredging requires that anyone proposing to engage in dredging or related activities which increases runoff, erosion and sediment must, prior to undertaking such activities, submit detailed plans to the New Hampshire Water Supply and Pollution Control Commission.

Soil Loss Limits. The Iowa law requires all conservation districts to establish soil loss limits and submit them to the State Soil Conservation Committee for approval. A soil loss limit is defined as the maximum amount of soil loss due to erosion by water or wind (in tons per acre per year) that the commissioners of each district shall determine, after hearing, as acceptable to meet the objectives of the law.

Ohio requires the adoption of rules to provide for the phased achievement over a period of years of the applicable soil-loss tolerance factors or permissable soil-loss values established by the U.S. Department of Agriculture.

The South Dakota law requires conservation standards, which it defines as soil loss tolerance limits.

Conservation Standards. The adoption of conservation standards, criteria, and guidelines by the state conservation agency, the conservation district, or both agencies, is required in Delaware, the District of Columbia, Hawaii, Illinois, Maryland, Michigan, Minnesota, Montana, Nevada, New Jersey, North Carolina, Ohio, Pennsylvania, South Dakota, and Virginia. Minimum requirements are set out in the Georgia law.

Requirements for Permits. An approved or certified conservation plan is required by the laws or regulations of Delaware, the District of Columbia, Georgia, Maryland, New Hampshire, New Jersey, Ohio, Pennsylvania, South Carolina, Virginia, and the Virgin Islands prior to the issuance of permits for construction or other land-disturbing activities. In South Dakota, agencies with authority to issue permits must require compliance with district conservation standards.

Enforcement Provisions. Enforcement provisions vary in the state laws. Provisions for penalties, injunctions, or other legal actions to be brought by districts or by the county or other governmental unit exist in the laws of Delaware, the District of Columbia, Georgia, Maryland, Michigan, Montana, Nevada, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, South Dakota, Virginia, and the Virgin Islands.

The Iowa law requires that upon receipt of a substantial complaint, the district commissioners shall issue an administrative order to the landowner stating the extent to which erosion exceeds established limits. This administrative order is enforceable by court order. The law applies to both rural and urban lands, and complaints have been received with respect to urban lands. However, it appears to be considerably more difficult to apply the soil loss equation to urban lands than to rural lands.

In Ohio, enforcement procedures are provided with respect to animal waste, but violations may not be prosecuted where public funds are not available for 75% of the cost of required practices.

In Pennsylvania, the Department of Environmental Resources has the responsibility for inspection and enforcement, and this agency may delegate enforcement to local jurisdictions.

The Illinois law provides for complaints to be filed with conservation districts on erosion and sediment control violations. Districts are then obliged to hold hearings with respect to such violtions and publish reports thereon. This reflects an intent to retain the voluntary character of the program, with enforcement depending primarily on cooperation and a landowner's desire to avoid publicity for violations.

Cost Sharing. In Iowa, 50 percent cost sharing is available for voluntary installation of conservation practices. Landowners can receive 75 percent of the cost of installing a practice when ordered by the soil conservation district to abate a nuisance as determined by the district pursuant to a complaint alleging violation of established soil loss limits. No new conservation practice can be required unless cost sharing funds are available. An amendment to the law in 1979 provided that a landowner cannot be required to spend more than $10.00 per acre per year times the number of acres owned in any one year to establish mandatory soil and water conservtion practices.10/ Experience in Iowa has demonstrated that the availability of cost sharing assistance has markedly increased the voluntary installation of conservation measures. The Iowa legislature has appropriated $5,000,000 for cost share assistance in each of the years of the 1979-81 biennium. However, requests for such assistance have far exceeded the funds available.11/

In Delaware, if there is not available to an owner or operator of agricultural or forest lands at least 50 percent cost sharing assistance or adequate technical assistance for carrying out an approved conservation plan, such owner or operator is not in violation of the act.

The Illinois law requires that the programs of both the state agency and district shall provide for the sharing of part of the costs of enduring erosion and sediment control devices, structures, and practices, which are defined as any device, structure or practice designed for the control and prevention of soil erosion and air and water pollution for a period in excess of one year.

In Ohio, the Chief of the Division of Soil and Water Districts must identify practices eligible for cost sharing, the conditions for eligibility, construction standards and specifications, maintenance requirements, and the limits of cost sharing for practices. The practices must be limited to enduring improvements to real property used in conjunction with farming or silvicultural operations. Enduring practices require capital expenditures that are likely to exceed the economic return to the owner or operator and which abate soil erosion or degradation of water by animal waste or soil sediment.

The Minnesota conservation districts law authorizes the State Soil and Water Conservation Board to develop a statewide program to reduce or prevent sedimentation, flooding, and agricultural related pollution, and to allocate funds to districts for the purpose of cost sharing contracts for erosion control measures and water quality improvements.

It will be noted that neither Illinois nor Minnesota restrict cost sharing to agricultural or silvacultural activities. Minnesota's regulations governing cost sharing for control of erosion and sediment specifically provide for cost sharing in urban, as well as rural, areas.12/

RELATIONSHIPS BETWEEN VOLUNTARY AND REGULATORY PROGRAMS

These laws indicate a realization that regulatory authority has a part to play in dealing with the problem of erosion and sedimentation. They also recognize that the conservation districts' long-time voluntary program continues to play a major role in a succesful attack on the problem, and that the essential elements of an effective voluntary program -- research, education, technical assistance, and cost sharing -- must also exist in any program that includes manadatory enforcement authority.

The development of the soil and water conservation program on a voluntary basis was a natural evolution since a voluntary program suited the landowners and operators in rural areas where erosion and sediment control activities were concentrated for many years. On the other hand, in urban areas there has long existed regulatory mechanisms such as permits, inspections, licenses, and minimum standards in connection with the building, construction, community service, and safety and welfare functions. As the need developed for stronger controls to meet the increasing erosion and sediment problem, it has seemed only logical to use in combination those features of these two systems which could contribute to a resolution of the problem.

Illustrative of this combination of the two systems for promoting proper conservation of resources, is the requirement for the furnishing of an erosion and sediment control plan approved by a conservation district before a permit may be obtained for an undertaking involving land-disturbing activities. This establishes a close working relationship between the local governmental agency's regulatory authority and the technical assistance program of the conservation district. It will be noted in Appendix A that some ten states require an approved plan for the issuance of a permit; also, that eleven states provide for enforcement assistance by local governments, such as counties, cities, and towns, in carrying out local erosion and sediment control programs.

Further recognition of the important role of county and municipal governments in erosion and sediment control is evident in the provisions in the laws of Illinois, which encourages, and in Georgia, Hawaii, Maryland, Michigan, North Carolina, and Virginia, which authorize or require, the adoption of erosion and sediment control ordinances. In some states these ordinances are in addition to, and coordinated with, the programs required to be established by conservation districts. In others, the local governmental entity has primary responsibility through its ordinances for the erosion and sediment control program. Also, as indicated earlier, many counties and municipalities began some years ago to issue under their general powers ordinances for erosion and sediment control.

LEGISLATIVE TRENDS

In addition to the evident trend in state and local legislation to provide stronger measures for erosion and sediment control, is a trend to provide in such legislation for use of the resources of established regulatory systems of local governments in cooperation with the expertise and experience of conservation districts.

Another important trend is a growing realization of the importance of providing cost sharing, or other economic incentives, for installation and maintenance of conservation measures. Although cost sharing for conservation purposes has been heretofore focused primarily on rural and agricltural areas, some state laws, as has been noted, permit cost sharing in urban areas. No doubt there will be increasing interest in, and promotion of, some type of assistance, such as cost sharing or tax credits, to offset the increased costs of erosion and sediment control measures in connection with building and construction.

Although the general public may not yet be fully aware of the seriousness of the erosion and sediment control problem for both urban and rural America, progress is being made in that direction. Increased public awareness and concern will provide the greatest impetus toward the enactment of adequate legislation to make available funding, as well as other resources and authorities, necessary to ensure the eventual resolution, or at least containment, of the national erosion and sediment control problem in rural and urban areas.

FOOTNOTES

1. 16 U.S.C. 590 a-f
2. LA Rev. Stats. Sec. 3.1218 (1973)
3. Alabama, Arkansas, Colorado, Florida, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, Montana, Nebraska, Nevada, New Jersey, North Carolina, North Dakota, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.
4. Ann. Code MD Nat. Res. Sec. 8-1104 (1974, 1978 Supp.)
5. I.C.A. Sec. 467A.1 (1971, 1979 Pkt. Pt.)
6. Code of SC Sec. 48-13-10-48-13-60 (1976)
7. VI Code T. 12, Secs. 531-538 (1978 Cum. Supp.)
8. The Council of State Governments, Iron Works Pike, Lexington, Kentucky 40505
9. Report on State Sediment Control Institutes Program EPA-44/9-75-001
10. Iowa H.F. 22, (1979)
11. Information from Iowa Department of Conservation
12. 6 MCAR Sec. 7.004

SUMMARY OF PRINCIPAL PROVISIONS OF STATE LAWS PROVIDING FOR EROSION AND SEDIMENT CONTROL AS OF OCTOBER 1, 1979

Prepared By

MARY M. GARNER
Legal Consultant
NATIONAL ASSOCIATION OF CONSERVATION DISTRICTS

Twenty states, the District of Columbia, and the Virgin Islands have enacted erosion and sediment control legislation during the past decade. This includes legislation such as amendments to conservation districts laws, water quality laws, and erosion and sediment control laws. Some of these laws are broad in scope, whereas, others deal with specific areas of concern.

All of the laws contain some provision for enforcement of conservation requirements, most of which involve three general types of regulatory mechanisms: (1) Approved erosion and sediment control plan required for land disturbing activities; (2) Approved plan required for issuance of a permit for an activity involving land disturbing activities; (3) Requirement for compliance with established permissable soil loss limits.

A significant characteristic of most of these laws is the provision for cooperation and coordination between the various state agencies concerned with soil and water conservation and water quality, and between the state agencies and local units of government.

This summary is intended as a general indication of the principal provisions of these laws. For more complete information, reference should be made to the particular laws, citations to which are included on the last page.

Prepared by the National Association of Conservation Districts
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SUMMARY OF PRINCIPAL PROVISIONS OF STATE LAWS PROVIDING FOR EROSION AND SEDIMENT CONTROL

(A reference to the particular law will be essential for complete explanation of provisions)

PROVISIONS	Model Act & Alt. Provisions	Delaware	District of Columbia	Georgia	Hawaii	Illinois	Iowa	Maine	Maryland	Michigan	Minnesota	Montana	Nevada	New Hampshire	New Jersey	New York	North Carolina	Ohio	Pennsylvania	South Carolina	South Dakota	Virginia	Virgin Islands
TYPE OF STATE LAW																							
Erosion and sediment control	x	x	x	x	x				x	x					x		x	x		x	x	x	x
Conservation districts						x	x				x					x		x				x	
Water quality and stream control								x				x	x	x					1				
METHODS OF CONTROL																							
Approved erosion and sediment control plan required for land disturbance	x	x	x	x					x	x		x	39		x	x	x	x	2	x	26	x	x
Establishment of soil loss limits							x											x			x		
Permits on basis of an approved plan	x	x	x	x				36	x					x	23			x	x	x	27	x	x
RESOURCES COVERED																							
Natural resources	x	x		14	17	x			x						14								
Land	x	x	x	x	x	x			x				x		x	25					x	x	x
Soil	x	x	x			x	x	x		x	x			x			x	x		x			
Water	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Streams and streambanks												x					x		x				
EXEMPTIONS FROM LAW OR FROM PENALTIES																							
Agriculture and horticulture		33	x	x			3	37	x	19			33				x		4	x		5	x
Mining				x		x				x							x	x		x		x	
Homes or small sites			x	x	x	x			6						x					x		x	
Highways or railways				x			7															x	
Minor land disturbances	x	x	x	x	x	x													4	24		x	
Cost sharing assistance unavailable	x	x					x	x										x					
STATE CONTROL AGENCY																							
Participating agencies:																							
Soil and Water Conservation	x			x			x				x				x	x	x	x			x	x	x
Natural Resources		34		x			x		x	x		x					x	x					
Other			30	15	18	32		38		20		8	40	42	21		29	13	9				
State responsibilities:																							
Develop policies and programs	x	x				x	x			x	x				x		x		x			x	
Develop criteria standards, guidelines	x	x	x	16	x	x			x	x	x	x	x		x		x	x	x		x	x	
Adopt rules and regulations	x	x		x						x	x	x	x	x			x	x	x		x		x
Approve local programs or plans	x	x	x			x	x		x	x	x				x		x	x	x			x	x
Perform enforcement functions	x	x	x	x		x			x				x				x	x	x		x		x
Assist local agencies with:																							
Ordinances, regulations, and programs	x		x			x	x		x						x		x						
Enforcement			x			x			x	x								x					
Cost sharing	x	x				x	x				x	x			22			x					
Approve state and federal agency plans	x	x				x			x														
Adopt program if local agency fails to do so	x	x		x	x	x											x	x				x	x

NOTE: An "x" indicates that the respective law contains the provision listed; numbers refer to footnotes.

SUMMARY OF PRINCIPAL PROVISIONS OF STATE LAWS PROVIDING FOR EROSION AND SEDIMENT CONTROL

PROVISIONS	Model Act & Alt. Provisions	Delaware	District of Columbia	Georgia	Hawaii	Illinois	Iowa	Maine	Maryland	Michigan	Minnesota	Montana	Nevada	New Hampshire	New Jersey	New York	North Carolina	Ohio	Pennsylvania	South Carolina	South Dakota	Virginia	Virgin Islands
LOCAL CONTROL PROGRAM																							
Participating local agencies:																							
Conservation districts	x	x	31	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x
Counties	x	x		x	x				x	x		x	41		x		x	x	x	x	x	x	
Cities	x	x		x					x	x			41		x		x	x	x		x	x	
Towns or townships	x								x	x		x					x						
CONSERVATION DISTRICT RESPONSIBILITIES																							
Review and approve erosion and sediment control plans	x	x		x				x	x	x		x			x	x	x		x	x	26	x	x
Establish soil loss limits							x																
Assist county or other local agency develop ordinances or regulations		x			x				x	x								x					
Adopt standards, criteria, guidelines			31			x			x		x	x									x	x	
Adopt rules and regulations							x					x											x
Perform enforcement functions 10	x	x				x	x		x	x		12			x			x	x	x	x	x	
Adopt an erosion and sediment control program	x	x				x			x		x						x				x	x	x
COUNTY, CITY, TOWN, OR TOWNSHIP RESPONSIBILITIES																							
Adopt programs	x	35											41				x		x		x	x	
Review and approve plans	x								11	x							x	x	x				
Adopt ordinances	x			x	x				x	x							x	x					
Issue permits on basis of approved plan	x	x	x						x						23				x			x	
Perform enforcement functions 10	x	x	x						x	x					x		x	x	x	x	x	x	
Issue rules and regulations	x								x								x	x		x			

FOOTNOTES

1. Authorities contained in laws and regulations
2. Acceptable plan required at site of activity
3. Erosion control practices may not be required on land used for such purposes only
4. Exempted from permit requirements only
5. Except as to grading, excavating, or filling
6. Except in Calvert County
7. Within city limits
8. Department of Fish and Game
9. Department of Environmental Resources
10. May include permits, inspection, complaints, violation procedures, fines, other legal actions
11. In municipalities not within a district
12. Special provisions for emergency actions
13. Division of Soil and Water Districts
14. Air and other resources
15. Division of Environmental Protection of the Department of Natural Resources
16. Established by law
17. And other resources
18. Department of Health
19. Persons engaged in agriculture who have agreements with conservation districts are not subject to site plans, land use plans, or permits, but are subject to enforcement procedures
20. Department of Agriculture
21. Secretary of Agriculture and Commissioner of Environmental Protection
22. May assist with grants
23. Certification
24. Emergency repairs
25. Agricultural land as described in the law
26. Required where district determines that an agricultural land-disturbing activity is violating adopted standards
27. Permit issuing authorities must require compliance with district standards
28. Department of Public Works
29. NC Sedimentation Control Commission
30. DC Department of Environmental Services
31. DC Agencies engaged in land disturbing activities
32. State Department of Agriculture
33. Certain specified exceptions
34. Department of Natural Resources and Environmental Control
35. Political subdivisions not precluded from adopting more stringent programs
36. Waste discharge license required for discharge of any pollutant
37. For agricultural activities having an approved erosion and sediment control plan or conservation plan
38. Board of Environmental Protection
39. Initial design of project must provide measures to prevent pollution
40. State Environmental Commission
41. State Department of Conservation and Natural Resources may delegate authority as to diffuse sources (non-point)
42. NH Water Supply and Pollution Control Commission.

EROSION AND SEDIMENT CONTROL LEGISLATION
October 1, 1979

Delaware	Erosion and Sediment Control Act Del. S.B. No. 353, June 30, 1977
District of Columbia	Soil Erosion and Sediment Control Act of 1977 D.C. Law 223, September 23, 1977
Georgia	Erosion and Sedimentation Act of 1975 Ga. Code Ann. Secs. 5-2301a—5-2313a (1975 Rev., 1979 Cum. Pocket Part)
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Maine	Water Pollution Abatement Licensing Program* Me. H.P. 1185-L.D. 1458, Approved June 8, 1979
Maryland	Sediment Control Act Ann. Code Md., Nat. Res., Sec. 8-1101—8-1108 (1974, 1978 Cum. Supp.)
Michigan	Soil Erosion and Sedimentation Control Act Mich. Stats. Ann. Secs. 13.1820(1)—13.1820(17)
Minnesota	Soil and Water Conservation Minn. Stats. 40.005-40.15
Montana	The Natural Streambed and Land Preservation Act of 1975* R.C.M. Sec. 26-1510—26-1523 (1947, 1975 Cum. Pocket Supp.)
Nevada	Act Providing for the Control of Water Pollution From Diffuse Sources* Nev. Rev. Stats. Sec. 445.131 et seq.; Nev. A.B. 572, May 26, 1979
New Hampshire	Dredging Law* N.H. RSA 149:8-A
New Jersey	Soil Erosion and Sediment Control Act N.J. Stats. Ann. Sec. 4:24-17.5—4:24-55
New York	Soil and Water Conservation Law McKinneys Cons. Laws of N.Y., Book 52-B
North Carolina	Sedimentation Pollution Control Act of 1973. Gen. Stats. N.C. Secs. 113A-50—113A-66 (1975, 1979 Supp.)
Ohio	Agricultural Pollution Abatement and Urban Sediment Pollution Abatement Ohio HB 513, Approved Oct. 13, 1978 Page's Ohio Rev. Code Ann. Secs. 1515.01.30, .32, .33, .99; 307.79, .791; 6111.04, .44; 305.31, .32, .35, .42
Pennsylvania	The Clean Streams Laws of Pennsylvania* 35 Pa. Stats. Secs. 691.1 et. seq. (1977)
South Carolina	County Sediment Control Programs Code of Laws of S.C. Secs. 48-13-10—48-13-60 (1976)
South Dakota	Act to Regulate Land-disturbing Activities Within the State, Resulting in Soil Erosion and Sediment Damage S.D.C.L. Secs. 38-8A-1—38-8A-21 (1977)
Virginia	Erosion and Sediment Control Act Code of Va. Tit. 21, Ch. 1, Secs. 21-89.1—21.89.15 (1978 Cum. Supp.)
Virgin Islands	Environmental Protection, Shore and Erosion Control V.I. Code Tit. 12, Secs. 531-538 (1978 Cum. Supp.)

*Law includes authority for erosion and sediment control among other authorities.

SUMMARY OF PRINCIPAL PROVISIONS OF STATE LAWS PROVIDING FOR EROSION AND SEDIMENT CONTROL AS OF OCTOBER 1, 1979

Prepared By

MARY M. GARNER
Legal Consultant
NATIONAL ASSOCIATION OF CONSERVATION DISTRICTS

Twenty states, the District of Columbia, and the Virgin Islands have enacted erosion and sediment control legislation during the past decade. This includes legislation such as amendments to conservation districts laws, water quality laws, and erosion and sediment control laws. Some of these laws are broad in scope, whereas, others deal with specific areas of concern.

All of the laws contain some provision for enforcement of conservation requirements, most of which involve three general types of regulatory mechanisms: (1) Approved erosion and sediment control plan required for land disturbing activities; (2) Approved plan required for issuance of a permit for an activity involving land disturbing activities; (3) Requirement for compliance with established permissable soil loss limits.

A significant characteristic of most of these laws is the provision for cooperation and coordination between the various state agencies concerned with soil and water conservation and water quality, and between the state agencies and local units of government.

This summary is intended as a general indication of the principal provisions of these laws. For more complete information, reference should be made to the particular laws, citations to which are included on the last page.

Prepared by the National Association of Conservation Districts
under Environmental Protection Agency Grant No. T 900 704-02

SUMMARY OF PRINCIPAL PROVISIONS OF STATE LAWS PROVIDING FOR EROSION AND SEDIMENT CONTROL

(A reference to the particular law will be essential for complete explanation of provisions)

PROVISIONS	Model Act & Alt. Provisions	Delaware	District of Columbia	Georgia	Hawaii	Illinois	Iowa	Maine	Maryland	Michigan	Minnesota	Montana	Nevada	New Hampshire	New Jersey	New York	North Carolina	Ohio	Pennsylvania	South Carolina	South Dakota	Virginia	Virgin Islands
TYPE OF STATE LAW																							
Erosion and sediment control	x	x	x	x	x				x	x					x		x	x		x	x	x	x
Conservation districts						x	x				x					x		x				x	
Water quality and stream control								x				x	x	x					1				
METHODS OF CONTROL																							
Approved erosion and sediment control plan required for land disturbance	x	x	x	x					x	x		x	39		x	x	x	x	2	x	26	x	x
Establishment of soil loss limits							x											x			x		
Permits on basis of an approved plan	x	x	x	x				36	x					x	23			x	x	x	27	x	x
RESOURCES COVERED																							
Natural resources	x	x		14	17	x			x						14								
Land	x	x	x	x	x	x			x				x		x	25					x	x	x
Soil	x	x	x			x	x	x		x	x			x			x	x		x			
Water	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Streams and streambanks												x					x		x				
EXEMPTIONS FROM LAW OR FROM PENALTIES																							
Agriculture and horticulture		33	x	x			3	37	x	19			33				x		4	x		5	x
Mining				x		x				x							x	x		x		x	
Homes or small sites			x	x	x	x			6						x					x		x	
Highways or railways				x			7															x	
Minor land disturbances	x	x	x	x	x	x													4	24		x	
Cost sharing assistance unavailable	x	x					x	x										x					
STATE CONTROL AGENCY																							
Participating agencies:																							
Soil and Water Conservation	x			x			x				x				x	x	x	x			x	x	x
Natural Resources		34		x			x		x	x		x					x	x					
Other			30	15	18	32		38		20		8	40	42	21		29	13	9				
State responsibilities:																							
Develop policies and programs	x	x				x	x			x	x				x		x		x			x	
Develop criteria standards, guidelines	x	x	x	16	x	x			x	x	x	x	x		x		x	x	x		x	x	
Adopt rules and regulations	x	x		x						x	x	x	x	x			x	x	x		x		x
Approve local programs or plans	x	x	x			x	x		x	x	x				x		x	x	x			x	x
Perform enforcement functions	x	x	x	x		x			x				x				x	x	x		x		x
Assist local agencies with:																							
Ordinances, regulations, and programs	x		x			x	x		x						x		x						
Enforcement			x			x			x	x								x					
Cost sharing	x	x				x	x				x	x			22			x					
Approve state and federal agency plans	x	x				x			x														
Adopt program if local agency fails to do so	x	x		x	x	x											x	x				x	x

NOTE: An "x" indicates that the respective law contains the provision listed; numbers refer to footnotes.

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LOCAL CONTROL PROGRAM																							
Participating local agencies:																							
Conservation districts	x	x	31	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x
Counties	x	x		x	x				x	x		x	41		x		x	x	x	x	x	x	
Cities	x	x		x					x	x			41		x		x	x	x		x	x	
Towns or townships	x								x	x		x					x						
CONSERVATION DISTRICT RESPONSIBILITIES																							
Review and approve erosion and sediment control plans	x	x		x				x	x	x		x			x	x	x		x	x	26	x	x
Establish soil loss limits							x																
Assist county or other local agency develop ordinances or regulations		x			x				x	x								x					
Adopt standards, criteria, guidelines			31			x			x		x	x									x	x	
Adopt rules and regulations							x					x											x
Perform enforcement functions 10	x	x				x	x		x	x		12			x			x	x	x	x	x	
Adopt an erosion and sediment control program	x	x				x			x		x						x				x	x	x
COUNTY, CITY, TOWN, OR TOWNSHIP RESPONSIBILITIES																							
Adopt programs	x	35											41				x		x		x	x	
Review and approve plans	x								11	x							x	x	x				
Adopt ordinances	x			x	x				x	x							x	x					
Issue permits on basis of approved plan	x	x	x						x						23				x			x	
Perform enforcement functions 10	x	x	x						x	x					x		x	x	x	x	x	x	
Issue rules and regulations	x								x								x	x		x			

FOOTNOTES

1. Authorities contained in laws and regulations
2. Acceptable plan required at site of activity
3. Erosion control practices may not be required on land used for such purposes only
4. Exempted from permit requirements only
5. Except as to grading, excavating, or filling
6. Except in Calvert County
7. Within city limits
8. Department of Fish and Game
9. Department of Environmental Resources
10. May include permits, inspection, complaints, violation procedures, fines, other legal actions
11. In municipalities not within a district
12. Special provisions for emergency actions
13. Division of Soil and Water Districts
14. Air and other resources
15. Division of Environmental Protection of the Department of Natural Resources
16. Established by law
17. And other resources
18. Department of Health
19. Persons engaged in agriculture who have agreements with conservation districts are not subject to site plans, land use plans, or permits, but are subject to enforcement procedures
20. Department of Agriculture
21. Secretary of Agriculture and Commissioner of Environmental Protection
22. May assist with grants
23. Certification
24. Emergency repairs
25. Agricultural land as described in the law
26. Required where district determines that an agricultural land-disturbing activity is violating adopted standards
27. Permit issuing authorities must require compliance with district standards
28. Department of Public Works
29. NC Sedimentation Control Commission
30. DC Department of Environmental Services
31. DC Agencies engaged in land disturbing activities
32. State Department of Agriculture
33. Certain specified exceptions
34. Department of Natural Resources and Environmental Control
35. Political subdivisions not precluded from adopting more stringent programs
36. Waste discharge license required for discharge of any pollutant
37. For agricultural activities having an approved erosion and sediment control plan or conservation plan
38. Board of Environmental Protection
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41. State Department of Conservation and Natural Resources may delegate authority as to diffuse sources (non-point)
42. NH Water Supply and Pollution Control Commission.

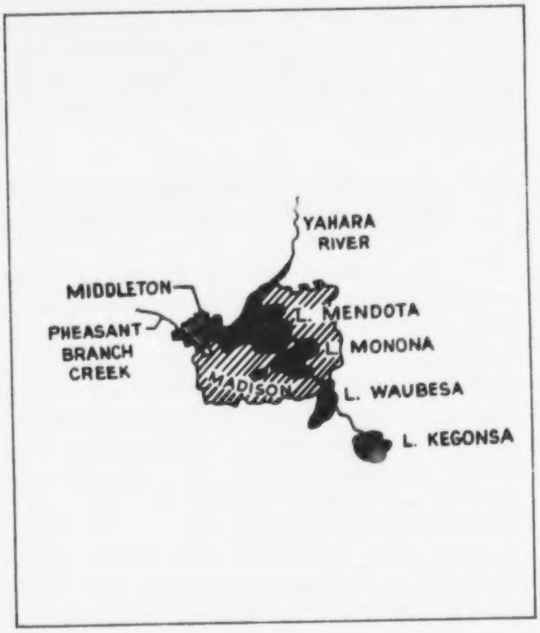
EROSION CONTROL IN A SUBURBANIZING AREA: THE CASE OF MIDDLETON, WISCONSIN

David Donoghue, P.E., City Engineer
William Feist, Alderman
Richard Lehmann, Plan Commissioner
Representing the City of Middleton Plan Commission

I. CHARACTERISTICS OF MIDDLETON

The City of Middleton is a 4th class suburban municipality occupying 5.59 square miles of land located on the west end of Lake Mendota in South-central Wisconsin. The City of Madison, population 171,113, abuts Middleton on the east and south.

MIDDLETON
MADISON



The estimated population of Middleton, as of January 1, 1979, was 11,956 people. The City has experienced rapid growth over the last 20 years. The 1960 Census Population was 4,410; the 1970 Census Population was 8,286. The growth in Middleton from 1970 to January 1, 1978, represents an increase of 37.2 percent, compared to a county-wide growth during the same period of 9.9 percent. Land use in the City of Middleton is made up of 58.47 percent (2,091.66 acres) residential; 8.32 percent (297.57 acres) business and commercial; 10.50 percent (375.8 acres) industrial; 15 percent (536.7 acres) agricultural; and 7.71 percent (275.82 acres) conservancy.

II. IMPORTANCE OF EROSION TO MIDDLETON

The City of Middleton has over one mile of frontage on Lake Mendota. The Pheasant Branch Creek passes west to east through the approximate center of the City. This creek drains a watershed of approximately 12,517 acres through a channel which has unstable banks, steep channel gradients, large peak flood flows and large amounts of sediment transport with subsequent deposition in downstream marsh areas and Lake Mendota deltas. Over 75,000 cubic yards of deposited material was dredged out of the lake in 1970-71 at the mouth of the Pheasant Branch Creek. This material was a direct result of erosion throughout the watershed. The City of Middleton has spent over $400,000 since 1967 in Creek and lakeshore improvements, primarily erosion protection and dredging.

Heavy agricultural erosion - sedimentation is a problem coupled with urban construction erosion problems due to rapid growth. Since all this sediment can enter Lake Mendota, the decline in lake quality is evident immediately. The City has attempted to protect important lands by acquisition, open space designation; as well as through zoning and by the development and enforcement of erosion control ordinances, including agricultural lands (requirement for establishing Soil and Water Conservation Plans). Attempts to form a watershed district with Federal assistance have been unsuccessful.

III. EXPERIENCE UNDER THE EARLIER ORDINANCE PROVISIONS LEADING TO DRAFTING OF THE NEW ORDINANCE

A. Experience in Problems and Enforcement. On November 3, 1970, the City adopted an ordinance creating a section of the Building Code which required Land Grading Permits. No person was allowed to excavate, grade, regrade or fill any building site or other parcel of land in any multi-family residential, commercial or industrial district without first obtaining a permit from the Building Inspector. This ordinance also applied to any building site or other parcel of land exceeding 25,000 square feet in area, or any portion of a parcel exceeding 25,000 square feet in a Single Family or Single Family Attached Zoning District. Problems experienced under this ordinance related to the excessive amount of erosion from single family home construction sites, tracking of mud and dirt on the streets and erosion problems resulting from storm water runoff in the built up portions of the City. The ordinance lacked adequate performance criteria under which a determination of noncompliance could be made, and as a part of a building code, was difficult to enforce when land disturbing activities were conducted without the construction of a building.

B. The City realized its land grading permit ordinance adopted in 1970 was inadequate for controlling erosion and for establishing water detention/retention requirements. Model ordinances were obtained in 1976 from other governmental agencies, primarily in Illinois. With the assistance of the Dane County Regional Planning Commission staff, a draft ordinance was prepared. After several drafts, a final draft was completed in early 1979 and submitted to the Common Council for public hearing and adoption. The ordinance was adopted June 5, 1979.

IV. THE NEW MIDDLETON, WISCONSIN, ORDINANCE

The ordinance is a "free standing" code under the legal authority of Section 62.11 (5) of the Wisconsin Statutes. This Statute codifies the principle of "municipal home rule." Under the Statute, the City Council "shall have power to act for the government and good order of the City, for its commercial benefit, and for the health, safety, and welfare of the public, and may carry out its powers by license, regulation, suppression, borrowing of money, tax levy, appropriation, fine, imprisonment, confiscation, and other necessary or convenient means." The ordinance has ties to the City's zoning ordinance and to municipal subdivision regulation and is referenced in both of those ordinances.

The ordinance addresses itself to land disturbing activities or uses (including tilling, removal of ground cover, grading, excavating and filling) occurring in the course of development or alterations in developed property. Agricultural land uses are exempt, as are home gardens.

The code applies within the City and within a belt of land located within 1½ miles of the City (the municipal extraterritorial area).

Three Categories of Application

One part of the ordinance applies to projects with erosion and sedimentation potential. This part defines a category of land disturbing activities which require prior approval before they can begin and close supervision thereafter. These are:

1. Earth-moving disturbances involving either 5,000 square feet or more of area or 500 cubic yards or more of fill or excavation; or

2. Work on any public road; or

3. Work on any water course; or

4. Governmental or utility trenching involving more than 300 linear feet; or

5. All land subdivisions.

These "erosion prone" land disturbing activities require a permit, based on City review of a plan (described later). The standard which applies to these activities is the following:

> ". . . erosion and sedimentation during and after the land disturbance will not exceed that which would have been eroded if the land had been left in its undisturbed state and/or are controlled in accordance with specifications established in Minimizing Erosion in Urbanizing Areas as developed by the Dane County Soil and Water Conservation District in cooperation with the U. S. Department of Agriculture, Soil Conservation Service."

There is another category of land disturbing activity which, additionally, requires special controls on runoff. These are:

1. Residential developments of 5 acres or more; or

2. Non-residential developments of 3 acres or more; or

3. Residential development of any site when 50 percent of the site will consist of impervious surfaces; or

4. Any other project where:

> "In the opinion of the City Engineer, the runoff from the land disturbing activity will create a hazard by exceeding the safe capacity of the receiving water body in the area; or will cause undue channel erosion or an undue increase in water pollution by increased scour and transport of particles; or will otherwise endanger the downstream property owners or their property. Safe capacity is defined as the rate of flow that can be handled without flooding."

These "runoff control" projects require a plan and a City permit. Applications are tested against this standard:

> "Land disturbing activities subject to onsite detention and runoff control regulation under this ordinance shall not exceed the more stringent of the two following standards:
>
> "(a) The peak rate of runoff after the proposed activities shall not be greater than the peak rate which would have resulted from the same storm event occuring over the site of the proposed activity with the land in its natural undeveloped state, or
>
> "(b) The peak runoff rate shall be limited to a rate prorated on the basis of the safe capacity of the existing or proposed stormwater drainage facilities.
>
> "Further, land disturbing activities subject to onsite detention and runoff control regulation by this ordinance shall provide for detention of the increased stormwater runoff which would result from the proposed land disturbing activity. Storage shall be sufficient to store this increased runoff for a hundred year rainfall of any duration. Stormwater detention may be provided by the landowner/land user onsite or adjacent to the site or may be provided by the City of Middleton."

Finally, there is an "all other" category. In respect to projects not covered by the preceding language, the code provides:

"Any landowner, land occupier or land user who permits excessive erosion to adjacent land, public streets or bodies of water from land not otherwise subject to this ordinance shall be deemed in violation of this ordinance and subject to the penalties provided in section 28.17. Erosion is held to be excessive if, in the opinion of the City Engineer, an unsafe condition results in the streets, if undue sedimentation of lakes and streams occurs or if the public health, safety or general welfare of the citizens of the City of Middleton is harmed."

The Nature of the Standards

The standards are expressed in performance terms. Any structural measures which will accomplish the standards are eligible for consideration. The City is, however, to apply these principles to review of plans and projects:

"1. The smallest practical area of land shall be exposed at any given time during development.

"2. Such minimum area exposure shall be kept to as short a duration of time as is practicable.

"3. If at all practicable, temporary vegetation, mulching or other cover shall be used to protect areas exposed during development.

"4. Provision shall be made to effectively accommodate the increased runoff caused by changed soil and surface conditions during and after development according to the standards contained in this ordinance.

"5. Permanent, final plant covering or structures shall be installed as soon as possible.

"6. The plan of development shall relate to the topography and soils of the site so that the lowest potential for erosion is created.

"7. Natural plant covering shall be retained and protected and shall be deemed a dominating factor in developing the site."

In addition "The City Engineer shall not approve any plan nor issue a permit for any land disturbing activities under this ordinance unless he is satisfied that there will be adequate provisions to prevent the tracking or dropping of dirt or other materials from the site, onto any public or private street."

Regulatory Procedure

The erosion prone and runoff control projects require the landowner to apply for a special permit. The application shall include a plan for control of erosion, sedimentation and runoff. The plan has to show existing site conditions (including topo), a proposed work plan, and the proposed resulting topo and site conditions. Soil types (upper 6 inches) and cover have to be indicated. Calculations have to be made of surface runoffs and discharge upon 10 and 100 year frequency storms. Design assumptions have to be articulated, as do costs of the facilities included in the plan.

The plan is reviewed by the City Engineer. The ordinance provides an option for small parcel owners to request and pay for the preparation of the plan for the City Engineer "if time permits him to do so." Applicants may appeal and review decisions of the City Engineer to the City Water Resources Management Commission.

Enforcement

An approved plan becomes binding upon the property owner and all work must comply with the plan and permit. The applicant is responsible for all costs. The cost assumption responsibility extends offsite.

The permittee ". . . must bear his proportionate share of the total cost of offsite improvements to drainageways based upon the existing developed drainage area or planned development of the drainage area, as determined by the City Engineer . . ." In the event the applicant fails to do the work indicated on the approved plan, the City Engineer is authorized ". . . to perform any work or operations necessary to bring the condition of the lands into conformity with the approved control plan or plan as modified by the City Engineer and . . . the total of the costs and expenses of such work and operations (are placed) upon the tax roll as a special tax against the property."

The approved plan has a timetable. In any event, permits under the ordinance expire after six months unless specially extended.

Inspections must be called for at the start and end of earthmoving work. The applicant consents to municipal inspection access as a condition of the permit.

Violations subject the responsible parties to the possibility of forfeiture (not less than $20 nor more than $200 per day) or injunction or to direct remedial work by the City with costs assessed to the property. The property owner is responsible for repairing any damage to lands or drainageways caused by runoff or sedimentation from activities not part of the approved plan.

Variances and appeals are assigned to the City's Water Resources Management Commission.

V. IMPLEMENTING THE NEW MIDDLETON ORDINANCE

With the adoption of the City's current Erosion Control Ordinance, staff has begun an educational period prior to strict enforcement of the ordinance. As single family home builders and other contractors, including utility contractors, apply for street opening permits or building permits, they are given a copy of the new Erosion Control Ordinance and advised of the new requirements under which they will be expected to conduct their construction operations. Contractors are also given a copy of a paper entitled "Methods for Controlling Erosion and Sedimentation from Residential Construction Activities," by B. B. Hagman and J. G. Konrad, Bureau of Water Quality, Wisconsin Department of Natural Resources, which provides a listing of no cost practices that can be implemented to control erosion during construction of single family homes. They are encouraged to utilize these practices in any new construction they undertake. To date, all contractors have indicated a willingness to comply with the new ordinance and have initiated some of the recommended practices, including removal of the excavated material upon backfilling of the basement walls, at which time they are now rough grading the lots. The only negative comment received from contractors to date relates to the costs that would be added to home construction in locations where the topography creates unusual circumstances. One contractor has indicated that he would anticipate an additional $3,000 in costs to implement the erosion control practices necessary to keep the sediment on site. In the majority of instances, staff estimates additional costs to the contractor to range between $500 - $1,000 per lot in order to employ the practices required by the new ordinances to prevent erosion.

Full copies of the City of Middleton Ordinance on Erosion Control and Storm Water Runoff can be obtained from the City Engineer, 7426 Hubbard Avenue, Middleton, Wisconsin 53562.

DEVELOPMENT OF COMPREHENSIVE EROSION CONTROL AND STORMWATER MANAGEMENT ORDINANCES IN DANE COUNTY, WISCONSIN

F. Brandt Richardson
Senior Hydrologist
Minnesota Water Planning Board
St. Paul, Minnesota

David E. Stewart
Consulting Attorney
Madison, Wisconsin

The control of erosion from construction sites and the mitigation of urban stormwater are essential components of a proposed strategy for improvements in the water quality and recreational use of the Madison (Wisconsin) chain-of-lakes (Dane County Regional Planning Commission, 1979). In conjunction with area-wide water quality management planning for Dane County, efforts were made to assess the relative significance of non-point sources of pollution and to determine the adequacy of current land management techniques. Conclusions regarding the inadequacies of existing efforts and the development of a comprehensive model ordinance for regulation of construction site erosion and stormwater management may have applicability to other communities contemplating non-point source pollution control.

The Madison lakes (Mendota, Monona, Wingra, Waubesa, and Kegonsa) exhibit the effects of cultural eutrophication (Sonzogni and Lee, 1974, 1975) as a result of nutrient loads from various agricultural and urban sources. In addition, these sources cause localized impairment of the recreational capacity of the lakes, necessitating dredging in several locations. The sedimentation has also enabled extensive development of aquatic macrophytes, requiring use of both chemical and mechanical controls.

To reduce nutrient and sediment loads to these lakes, the Dane County Regional Planning Commission (DCRPC) established a water quality management planning process which included (1) water quality monitoring to assess the magnitude and importance of various sources of pollutants, (2) review of existing management techniques including public works practices and erosion controls, and (3) an analysis of institutions and legal authorities for development of a non-point source pollution reduction program. These activities have evidenced the need for infiltration and on-site detention of stormwater to reduce the transport of various urban contaminants. The following discussion is limited to

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consideration of potential sediment yield from construction sites and delivery by urban stormwater.

Significance of Construction-Related Sediment

There is substantial documentation regarding the potential sediment yield from construction sites (Wolman and Schick, 1967) which suggests a range of yield from 1.5 to 220 tons/acre/year, with many observed values near the upper end of this range. (In contrast, results of research in the Madison area indicate that stable, fully-developed urban catchments yield sediment at a rate approximating 1 ton/acre/year).

Additional local evidence for the significance of sediment yield from construction sites was provided by water quality monitoring undertaken by the DCRPC. The largest urban sediment yield was monitored in a catchment with substantial construction activity. Comparison of storm-event data in stable and urbanizing catchments indicated substantially larger sediment yields from the urbanizing catchment. Personal inspection of catchments with construction activity after storm events verified substantial soil losses from construction sites.

In response to these observations, an assessment of existing erosion control efforts was made. A review of regulatory efforts by all units of government in the county revealed limited attempts to require the application of erosion controls in seven of the sixty-one units of government, the most significant of which are discussed further in "Rationale for Development of a Model Ordinance".

Construction Site Erosion Control Practices Inventory

In addition to interviewing local officials and employees concerning construction erosion control ordinances, staff from the Dane County Regional Planning Commission surveyed construction sites in September 1976 to assess the adequacy and extent of application of erosion control practices.

Survey Methods

Construction sites were located in all five cities, eight of twenty villages, and five of thirty-five towns in Dane County. In the City of Madison, the survey covered all construction areas within the four basins selected for water quality monitoring. Building inspectors in all cities were contacted to indicate areas of significant construction activity, and the remaining sites were identified by village and county officials.

Construction activity in 1976, as indicated by number of building permits issued, reached its highest level in 4-5 years and was representative of the level of activity in the last decade.

Basic information was collected for each site visited, including name of the project and general contractor, location, type and stage of construction, number of lots and estimated acreage of project, average and maximum slope, and nature of the drainage system. Presence of absence of erosion control practices was noted, and those practices observed were judged for adequacy. The presence of sheet and rill erosion, sedimentation and tracking was recorded. Results were tabulated according to project size, location and stage of construction (Dane County Regional Planning Commission, 1979).

Characteristics of Observed Sites

Sixty-eight construction projects, covering seven hundred and eighty-four acres, were included in the survey. Nearly one-half of the sites observed were small (less than two acres), but the twenty large projects (ten acres or larger) comprised eighty-nine percent of the acreage surveyed. Fifteen projects were classified as medium-sized (at least two acres, but less than ten).

Small projects were usually located within existing developments, but large projects were on the fringes of communities or in isolated tracts in the unincorporated area. The fifty-nine projects within cities and villages comprised about one-half the land surveyed; the other nine projects were located in unincorporated areas of the county.

Application of Erosion Control Practices

Over one-half of all projects observed were devoid of "erosion control practices", defined to include any observable practice which would decrease the erosion or transport of sediment from a construction site. Excluding gravel entrances (which reduce the tracking of sediment) from the definition, only sixteen of the fifty-one active projects had erosion control practices, and no project less than five acres employed any technique to reduce erosion. Most practices provided only minimal protection from erosion. Two practices -- gravel entranceways and seeding-mulching -- accounted for nearly all of the observed practices, and observed mulching rates were often inadequate. Only five of the fifty-one active projects employed any other erosion control techniques; these five were all large projects located in unincorporated areas subject to the county subdivision ordinance, which includes provisions for an optional erosion control plan.

Observed Erosion, Sedimentation and Tracking

Each construction project was examined for observable erosion and/or "tracking" - the transport of sediment off the site on tires of construction vehicles. Of the 51 active projects, 32 (62.7%) exhibited sheet-rill erosion and/or the deposition of eroded sediment. If the 12 freshly excavated sites are disregarded, 32 of the 39 active sites (82.1%), with exposure to rainfall, showed erosion and/or sedimentation. Because of the extremely dry months preceding the observations, these results may underestimate the extent and severity of erosion which would normally occur.

One-third of the active construction sites displayed some degree of tracking. Most gravel entrances were installed as bases for future paved entrances, and entrances and exists were made elsewhere on many sites. Gravel entrances, as installed and used, were often not intended or functioning as devices to reduce tracking.

Significance of Observations

The inventory of erosion control practices documented the deficiency of existing attempts to control sediment yield from construction sites in all governmental jurisdictions surveyed. The results suggest four specific problems:

(1) Inattention to erosion control practices is extensive, crossing all stages of construction, units of government, and sizes of projects.

(2) Small projects of less than ten acres exhibited a total absence of erosion control practices. The significance of small-acreage projects (usually small developments of single-family homes) can be underestimated as a source of localized problems. The relatively higher delivery ratios in storm-sewered areas, where most of such development occurs, magnifies the significance of these sources.

(3) Many observed erosion control practices were inadequately applied. Inspection of these practices by the staff soil scientist, and the observed erosion and sedimentation, suggested insufficiency of those practices applied and lack of compliance with standard criteria for application.

(4) Those governmental units which have enacted erosion control ordinances are not effectively controlling erosion. Only those subdivision ordinances involving the submission of erosion control plans achieved even moderate success, due to the greater facility of placing controls on large projects and to increased attention from elected officials.

Reasons for the failure of existing regulatory attempts cannot be directly determined or evidenced. However, some inferences can be made which reveal common difficulties in administering regulatory efforts. These inferences are further developed in "Rationale for Development of a Model Ordinance".

A principal concern is the lack of specific criteria for selecting erosion control practices. Local administrators are required to use considerable discretion in the selection of adequate and equitable erosion control measures. A specific methodology, such as the Universal Soil Loss Equation (Meyer and Ports, 1976), in conjunction with a standardized acceptable soil loss rate set by the local unit of government, would relieve the burden of justification from administrators and would ensure long-term consistency.

Problems with proof of violation are inherent in ordinances with generalized provisions which prohibit erosion or sedimentation. Enforcement of these restrictions has usually been in response to nuisance complaints, and demonstration of violation is complicated after the actual storm event or where several sources are involved.

A final impediment is the lack of inspection and enforcement of erosion control plans after issuance of a required permit.

Rationale for Development of a Model Ordinance

The inventory of construction erosion control practices in Dane County, Wisconsin demonstrated the need for some method of reducing the sedimentation resulting from this activity. The search of the ordinances of all units of government within Dane County (cities, villages, towns and the county itself) revealed that the control/detention provisions, if any, were interspersed throughout the adopting unit of government's ordinances.

Specifically, it was found that both the City of Madison (pop. 170,000) and Dane County (pop. 240,000) imposed erosion and sedimentation control requirements upon land division/subdivision activities occurring within their respective jurisdictions. Dane County required the use of certain control techniques and reserved the right to require the submission of a control plan as part of the subdivision process. Similarly, Madison's ordinance required the submission of a plan to control erosion and surface water drainage for every subdivision plat.

But neither unit of government imposed any effective controls over erosion occurring at individual building sites. Madison had an ordinance which sought or prohibit any activity at a construction site which allowed erosion to adjacent lands, public streets, bodies of water and also prohibited tracking of dirt or other materials off of the site. However, this ordinance required no submission of plans to control such erosion. To enforce the ordinance, the city was required to prove that a particular individual's construction site activity caused sedimentation off the site.

The cities of Monona (pop. 10,000) and Middleton (pop. 10,000) both sought to regulate erosion resulting from excavation grading, regrading or filling on certain land by requiring the person undertaking the activity to first obtain a grading permit. Monona imposed this requirement upon any parcel of land zoned commercial, industrial or multi-family residential. Similarly, Middleton required a permit for such activities on all land zoned commercial and industrial but also imposed the requirement upon all residential and limited business parcels exceeding 25,000 ft. Both ordinances were administratively tied to the building permit process; however, the clear wording of each required the applicant to seek a grading permit even for land disturbing activities which did not involve construction of a building.

Similar standards for the issuance of grading permits were set out in both city ordinances. The ordinances required each city engineer to review the erosion control features proposed and the timing proposed for installation. If the reviewing city engineer found the control features to be adequate "to prevent the runoff of earth and silt onto adjacent parcels of land, streets, highways and water ways upon completion of the project," then the respective building inspector (Monona or Middleton) issued the permit. A fair reading of this standard shows that it simply requires that land disturbing activity be stabilized after the activity is completed. It does not contain any criteria to assist the city engineer in determining what constitutes adequate stabilization. Even more importantly, it does not set out any restraints limiting erosion/sedimentation during the land disturbing activity.

Based upon this review of the ordinance, it was concluded that no governmental unit had an effective ordinance to control erosion/sedimentation resulting from single family residential construction. Both the Monona and Middleton ordinances specifically exempted such construction activities, and the Madison ordinance was ineffective because regulation was limited to only those construction sites where the city could prove the sedimentation was caused by a particular activity. In addition, the lack of adequate criteria in the performance standards made enforcement less effective. The ordinances (Madison and Dane County) which sought to control erosion or sedimentation resulting from regulated land division/subdivisions were adequate to control these activities; however, they were generally ineffective once construction of individual residences began. Ineffectiveness occurred because these ordinances only regulated the actual subdivision of the land and not the construction of homes on the subdivision lots. Thus, the development of a more comprehensive ordinance was undertaken.

Important Aspects of the Model Ordinance - Overview

This model seeks to regulate erosion-sedimentation from general land disturbing uses (nonagricultural) and to control runoff on lands larger than a given minimum area, with this minimum to be chosen by the adopting unit of government. Both the regulation of land disturbing activities (resulting in erosion or sedimentation) and the control of runoff are guaranteed through the use of a single permit. The permitting process typically requires the submission of a control plan, a permit application and the appropriate fee as set out in a fee schedule as adopted by the governing body either in the ordinance or in a contemporaneous resolution. However, this model optionally provides that the adopting unit of government (upon receipt of a request by the applicant and receipt of an additional fee) may prepare plans in lieu of plan preparation by the applicant.

It is intended that any governmental unit which adopts this model will also make contemporaneous amendments to both their building code and subdivision control ordinances prohibiting the issuance of a building permit and withholding plat approval until a permit is obtained under the provisions of this model. Clearly, it is intended that the typical subdivision of land and building of residences would require two permits under this ordinance (unless the subdivided is also the builder). First, a permit would be required for the land disturbing activity, the subdivision of the land and second, the building of the homes would generally also come under the permitting process (unless involving land of less than the minimum area as specified in the ordinance.)

Administration

The keystone of the administration of this ordinance is the land distrubing activity permit (permit). The model provides that no one may undertake any land disturbing activity regulated under this ordinance (see following discussion of Activities Regulated) without receiving a permit prior to commencing the proposed activity. However, there are several optional exceptions to this permit requirement provided in the model for use in relieving the single family residence from the full impact of the ordinance. These exceptions are provided for use in the event that political realities require special treatment of single family residences.

The authors believe that there is no basis for exceptions because there are adequate low cost technical control practices available to control erosion-sedimentation from single family residential construction. To relieve the single family home from the permit requirement makes any regulation difficult. The permit provides the administrator with effective notice regarding proposed land disturbing activity and without a permit it would be difficult to impose any controls over single family residences.

The model provides that every applicant for a permit must develop a plan to control erosion/sedimentation and/or runoff which would result from the proposed activity. The administrator of the ordinance is required to evaluate the control plans to determine whether they adequately meet the standards (discussed subsequently) imposed by this model for erosion-sedimentation and runoff control. As alternatives, the model provides two exceptions to the control plan requirements. The adopting governmental unit may choose to have the administrator or other government agency prepare the control plan for single family resident applicants or others. Additionally, or as a separate alternative, the governmental unit may waive the preparation of a control plan if the applicant agrees to implement all itemized control techniques. These alternatives were suggested specifically for single family residences.

The model requires the administrator to review all applications and control plans within 30 days. If he approves the application, the administrator is required to issue the permit. Further, the model imposes conditions upon the permit. The permittee is required to maintain all the improvements provided in the plan and to give notice prior to commencement of the land disturbing activities. Additionally, the permittee is required to grant the administrator access to the site for the purpose of inspecting the activity.

Activities Regulated

Land disturbing activity is broadly defined by the ordinance to include any change to land which may result in soil erosion, sedimentation and/or increased runoff, but specifically exempts home gardens, private road maintenance and agricultural uses. The model ordinance seeks to regulate proposed land disturbing activities of a certain magnitude or type. The governmental unit must determine certain threshold values when adopting this ordinance and is urged to make it applicable to all single family residential construction activities.

The model suggested threshold values and proposed that the following land disturbing activities are subject to the erosion and sediment control provisions of the ordinance, if:

(1) An area of 5,000 ft. or greater will be excavated, filled, graded or have ground cover removed;

(2) 500 cubic yards will be excavated or a fill or cut of three feet is proposed;

(3) Work on any public road, street, or highway is undertaken;

(4) Utility trenching will involve more than 750 linear feet; or

(5) The proposed division of land is also regulated by the governmental unit subdivision ordinances (i.e., a subdivision plat is required).

The 5,000 ft. minimum was included in the ordinance in an attempt to regulate single family construction while still exempting additions, extensions and modifications to homes.

Similarly, the model proposes to subject the following land disturbing activities to the onsite detention and runoff control provisions, if:

(1) The proposed activity is a residential development of five acres or more;

(2) The proposed activity is a residential development of five acres or less and 50 percent or more of the area will be impervious surfaces;

(3) The proposed activity is a non-residential development of three acres or more; or

(4) The proposed activity will cause excessive runoff.

Additionally, the model seeks to control situations not otherwise subject to the ordinance where sedimentation of adjacent land, public streets and water occurs.

Standards Used To Evaluate Control Plans

The governmental unit adopting the model ordinance must designate the authority (i.e., city engineer, public works department, etc.) responsible for administering the ordinance. It is this administrative authority which receives all permit applications and supporting control plans from anyone who proposes to undertake a land distrubing activity regulated by the ordinance. The model ordinance requires evaluation plans for compliance with the erosion/sedimentation and on-site detention/runoff control requirements. No permit may be issued unless the control plan will meet the applicable standards.

Most of the proposed standards are of the performance type and simply specify the degree of control which a proposed plan must obtain. The adopting unit of government must select the standards which it wishes to use.

The model proposes the following alternative standards for evaluating erosion and sedimentation control plans. The erosion during and after the land disturbing activity:

(1) Will not exceed a predicted average annual soil loss of 15 tons per acre the first year, and five tons per acre for any subsequent year that the disturbance continues and will be designed to not exceed one ton per acre after the disturbance is completed;

(2) Will not exceed that which would have been eroded if the land had been left in its undisturbed state; or

(3) Will be controlled in accordnace with specification established in Minimizing Erosion In Urbanizing Areas as developed by Dane County Soil and Water Conservation Service in cooperation with the U.S. Department of Agricultural, S.C.S.

The model proposes that any land disturbing activity which is subject to on-site detention and runoff control regulation shall not exceed the more stringent of the two following standards:

(1) The peak rate of runoff after the proposed activities should not be greater than the peak rate which would have resulted from the same storm event occurring over the site of the proposed activity with the land in its natural undeveloped state, or

(2) The peak runoff rate shall be limited to a rate prorated on the basis of the safe capacity of the existing or proposed stormwater drainage facilities.

Most of the alternatives proposed by this model are performance standards and do not require the use of any particular type of structural or nonstructural measures to meet them. The authors believe the use of performance standards to be far superior to the designation of lists of technical devices to control erosion and runoff. By simply specifying the goal to be obtained both the designer and the reviewed have a criteria to prepare and evaluate the plan. Thus, the applicant for a permit may employ any techniques which are believed to be necessary to achieve the applicable standard. Of course, the techniques must follow accepted design criteria and engineering standards. Additionally, the model ordinance does provide general principles to assist the administrator in evaluating proposed control plans.

(Copies of the model ordinance can be obtained from the Dane County Regional Planning Commission, Room 114, City-County Building, Madison, Wisconsin 53709).

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THE DEVELOPMENT OF EROSION AND SEDIMENT CONTROL ORDINANCES IN THE CINCINNATI AREA

George A. Cummings
District Conservationist
U.S.D.A. Soil Conservation Service
Cincinnati, Ohio

When you think of Cincinnati, what do you think of? The Ohio River, Fountain Square, Riverfront Stadium, Kings Island, Greater Cincinnati Airport, or landslides? During the period 1927-1930, a landslide on the west side of Cincinnati destroyed some 40 houses. In 1973 the greater Cincinnati area was plagued with landslides that closed roads, damaged buildings and destroyed houses. In 1974, when a landslide occurred during construction of an interstate highway, the cost of correcting the problem was estimated to be more than $8 million. Today the estimated cost is $16 million.

In 1973, city officials, developers and service and professional organizations began holding meetings to plan a strategy for preventing landslides. A local citizen's group in Cincinnati, the Citizen Task Force on Environmental Quality, recommended to the city council's Intergovernmental Affairs Committee, that a cut-and-fill ordinance be proposed for Cincinnati.

Hamilton County, with Cincinnati as the county seat, has a total area of approximately 265,000 acres. Approximately 50,000 acres are still in agriculture, the rest is developed, is planned for development, or is being held till the price is right. According to a report of the Hamilton County Regional Planning Commission, 30 percent of the county - about 80,000 acres have slopes of 15 per cent or greater.

Earlier development of Cincinnati and the suburbs was largely located in the valleys and on the ridgetops. With advances in

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construction and earthmoving technology developers began using sites in hillside areas. On many of Cincinnati hillsides, high-rise buildings were constructed just below the ridge line or cluster apartment units run along the ridge and step down the slopes.

In the unincorporated areas of the county, developers have built large single family home subdivisions and clustered multi-family apartments. Most were built with very little attention to topography, geomorphology and slope. Instead, through extensive earthmoving, the sites were transformed to receive road and development patterns designed specifically for land with no topographic limitation. Often slope failure occurred because of poor cut and fill practices and disturbance of the hillside form.

Some of the problems caused by these hillside developments are erosion and sedimentation, stream pollution and flooding, loss of scenic areas for public use, loss of form and configuration of the hillside as a landscape element in urban design. The most critical problem however, is the landslides that result from disturbance of the natural slope. Depending upon the physical characteristic of the site, landslides in Cincinnati have carried downhill everything from part of a yard or a porch, to large sections of roads and group dwelling units.

What is a landslide? A landslide is a rapid mass movement of soil and rock moving downhill under the influence of gravity. Landslides are characterized by actual failures in the soil or rock structure with the part broken off carried downslope.

The Hamilton County Soil and Water Conservation District (SWCD), along with the Soil Conservation Service(SCS) played an important part in preparing the city's cut-and-fill ordinance. First the district suggested to the mayor, that he petition the Ohio Soil and Water Conservation Commission to annex the City of Cincinnati into the district. This was done and the district and the City of Cincinnati signed a memorandum of understanding.

While Cincinnati was preparing its cut-and-fill ordinance, two fast-growing suburban communities were hard at work developing sedimentation and erosion control ordinances. The cities of Forest Park and Blue Ash were using a model ordinance developed by

Don Urban, SCS Resource Conservationist, detailed at the time to work with the Ohio-Kentucky-Indiana Regional Council of Governments; the Soil Conservation Service; and the Hamilton County SWCD. This model ordinance used guidelines contained in ordinances in effect in Maryland, Virginia, and Pennsylvania.

Both cities signed memorandums of understanding with the district and their ordinances referred to the "Water Management and Sediment Control For Urbanizing Areas Handbook" prepared by SCS in Ohio, as a source of sediment control practices with standards and specifications. The most important part of the ordinances was that they established an approval procedure in which the conservation district reviews the proposed water management and sediment control plan and make comments on the plan to the city engineer before any construction is started. Plans have been processed quicker where a meeting between the developer, the city engineer, and the district occurred during the preliminary planning stages. Also, a copy of the water management handbook is given to the developer or his engineer to use as a guide for designing erosion control measures.

In June 1974, Blue Ash became the first city in the greater Cincinnati area to pass an erosion control ordinance and in August, Forest Park became the second. Cincinnati passed its cut-and-fill ordinance in November to help save the hillsides.

In Ohio, cities have the power of home rule and can pass laws without the approval of the state. In 1974, Ohio counties had no authority, basically, to pass erosion control ordinances. That changed in January 1979 with the approval of an urban pollution abatement program to be administered by the Ohio Department of Natural Resources, Division of Soil & Water Districts.

Before the state program was approved, however, Hamilton County was able to take some steps toward dealing with landslides and sediment problems. The first step occurred in July 1975 when the county commissioners, the City of Cincinnati, and the conservation district asked the Soil Conservation Service to conduct a soil survey of the county. The survey is scheduled for completion by December 1979. With the new soil survey, critical slide prone soils can be identified. This information can then be given to developers, consultants, and planning officials to plan for proper development in Hamilton County.

With the new ordinances, cities have to train their employees on selecting the proper erosion control practices and determining where they should be installed. The district, along with SCS is helping with training.

Enforcement of the ordinances has been one of the big problems. City inspectors have often assumed that what is on the plan will be installed. Many problems have occurred because a planned erosion control practice was not installed.

Some of the exemptions and requirements of the Cincinnati cut-and-fill ordinance are as follows:

A. No permit needed with excavation less than 5 feet in vertical depth or less than 100 cubic yards per 5000 square feet of site area.

B. No permit needed if fill is less than 5 feet in vertical depth or less than 100 cubic yards per 5000 square feet of site.

C. No excavating or filling shall cause any slope to become unstable, impose loads which may affect the safety of structures, or slopes; interfere with adequate drainage for the site area and drainage area of land adjacent to the site; obstruct, damage or in other ways adversely affect lawfully existing sewerage or drainage, public or private; cause a stagnant pond of water to form or cause erosion or sedimentation.

D. Show plans for all retaining walls, cribbing, vegetative provisions, erosion and sediment control measures, together with location of temporary and or permanent fencing or other protective devices to be constructed in connection with, or as a part of the proposed work.

E. Show a timing schedule and sequence indicating the anticipated starting and completion dates of the development sequence, - stripping and/or clearing, rough grading and construction, final grading, and vegetative establishment and maintenance.

F. A bond may be required.

G. A checklist for erosion and sedimentation control plan is given to each developer or engineer.

The suburban cities exemptions and requirements for erosion control ordinances are as follows:

A. No plan shall be required when an excavation or fill is less than 4 feet in vertical depth at its deepest point; does not result in a total quantity of more than 100 cubic yards of material on any lot, parcel, or subdivision; has no final slopes steeper than 1 foot vertical and 3 feet horizontal.

B. The location of all trees with a trunk diameter greater than 5 inches must be identified.

C. Detailed plans are required for all planned drainage provisions, retaining walls, and erosion and sediment control measures; a map is to be prepared that shows the drainage area of land adjacent to the site and estimated runoff in cubic feet per second, before and after construction. Estimated runoff is computed in accordance with current city storm drainage criteria.

D. The estimated cost of grading and/or filling and the cost of the required erosion control practices.

E. A performance bond is required in the amount of the estimated cost of the water management and sediment control measures.

Since 1974, four other municipalities have passed erosion control ordinances. They all require the developer to use the technical services of the conservation district and SCS. With the passage of the law establishing Ohio's Urban Pollution Abatement Program, both the counties and the townships can now require erosion control ordinances.

Since the landslides in 1973, Cincinnati and its suburbs have made a giant step toward controlling landslides, erosion, and sediment problems.

CHECKLIST FOR EROSION & SEDIMENTATION CONTROL PLAN
FOR
CITY OF CINCINNATI

A. 1. Apply for permit at Room 320-A, City Hall (phone 352-3431)

2. If applicant is not the owner of the property upon which the excavation, fill or grading is to be done, submit a letter, from the owner to the applicant, granting permission for the work.

3. Submit two(2) copies of a plan which shall:
   - a. Include the owner's name and address, and the names and addresses of abutting owners;
   - b. Include a plot plan, drawn to scale, and vicinity plan showing the location of the proposed work;
   - c. Include a contour map of the affected area showing the existing and proposed contours at 5-foot intervals;
   - d. Show the location of the top and toe of each proposed excavation, fill or grade;
   - e. Show the proposed amount of excavation, fill or grading in cubic yards;
   - f. Show the location of any existing and proposed streets;
   - g. Show the location of any existing and proposed buildings or structures on the subject property and within fifteen(15) feet of subject property;
   - h. Show the location of the proposed disposal site for any contemplated excess materials;
   - i. Show the location of any borrow sites;
   - j. Show the location of any existing watercourses, drainage, and sewer systems serving the property;
   - k. Show existing and proposed drainage structures, walls, cribbing and surface protection, and any necessary temporary earth restraining installations;
   - l. Show a plan for temporary and permanent drainage of the property, including any new or altered sewer systems;
   - m. Describe the proposed method for the protection of the soils from erosion;

n. Show additional information as may reasonably be required by the Director.

4. Unless waived, plans and specifications shall be prepared by a registered professional engineer and shall, in addition to (3) above;

a. Include a report showing the results of surface and sub-surface exploration, conditions of the land, and procedures for performing the operation;

b. Show plans of all drainage provisions which shall be of such design to adequately handle the surface runoff, together with a map showing the drainage area of all land tributary to the site, and estimated cubic foot per second runoff of the area served by any drain computed in accordance with current acceptable standards;

c. Include a description of the borrow material, and the method to be used for and the degree of its proposed compaction;

d. Show proposed preparation of existing ground surface to receive fill;

e. Show proposed terraces and paved ditches where necessary to control surface drainage and debris;

f. Show proposed sub-surface drainage if necessary for stability;

g. Show plans of all retaining walls, cribbing, vegetative provisions, erosion and sediment control measures, together with location of temporary and/or permanent fencing and other protective devices to be constructed in connection with, or as a part of the proposed work;

h. Show a timing schedule and sequence indicating the anticipated starting and completion dates of the development sequence - stripping and/or clearing, rough grading and construction, final grading and vegetative establishment, and maintenance, and the time of exposure of each area prior to the completion of effective erosion and sediment control measures.

These requirements may be waived or modified if the information submitted under(3) above is determined to be sufficient to adequately evaluate the application.

5. The requirements of (3) and (4) above may also be waived or modified if the applicant presents a certificate in writing of a registered professional engineer stating to the satisfaction of the Director, that the proposed excavation, fill or grading will not:
    a. Interfere with adequate drainage for the site area and the drainage area of land tributary to the site.
    b. Obstruct, damage, or adversely affect existing sewerage or drainage, public or private;
    c. Cause a stagnant pond of water to form;
    d. Create slope stability problems on subject and adjacent property; or
    e. That the proposed excavation or fill is in an isolated, self-contained area and that there is no apparent danger to adjacent public or private property.

B. Any sewer work shall be in accordance with Chapter 719, Sewers, of the Cincinnati Municipal Code, and the current rules and regulations of the Metropolitan Sewer District of Greater Cincinnati. Plans must be prepared by a registered professional engineer.

C. One (1) copy of the plan will be returned to the applicant showing changes or additions to be made.

D. Submit nine (9) copies of the final plan and specifications, with revisions made.

E. Permit fee shall be based on the quantity of earth or other material moved, ten dollars ($10.00) for the first one hundred (100) cubic yards(or fraction thereof), plus ten dollars($10.00) for each one thousand(1,000) cubic yards (or fraction thereof) in excess of one hundred(100) cubic yards.

F. A separate permit is required for each site involved.

G. Applicant will be notified when permit is ready.

CHECKLIST FOR EROSION & SEDIMENTATION CONTROL PLAN
FOR
FOREST PARK

A. Map with topographic feature of the project area.
   1. Vicinity sketch and boundary line survey.
   2. Location of any buildings, structures, utilities, sewers, storm and water drains on the site and property within 100 feet of the project site.
   3. Contours of the existing site at 2 foot intervals.
   4. Acreage of the project.
   5. Scale of map and north arrow.
   6. Name and addresses of owner, of developer, of technician who made the plan, and engineer responsible for engineering detail.
   7. Location by section, township, range, county and state.
   8. Name of the project area.
   9. Locate all trees with a trunk diameter of greater than (5) five inches, measured at a point (5) feet from the ground.

B. Map with proposed alterations to the area.
   1. Changes to land surface and vegetative cover.
   2. Areas of cut and fill.
   3. Detailed plans of storm water and erosion control facilities.
   4. Contours of finish areas at an interval that will adequately describe the FINAL topography.
   5. Structures, roads, paved areas, buildings.
   6. Utility easements and drainage easements.

C. Watershed area and runoff from project area.
   1. Drainage area in acres for each storm water and erosion control structure.
   2. Calculation of C.F.S. (Cubic Feet Per Second Runoff) prior to development and C.F.S. after development.
   3. Watershed above project area. (If applicable).
   4. Certification of the quantity of excavation and fill involved.

D. Starting and completion dates of project area.
   1. Date of cover removal.
   2. Date of temporary cover.
   3. Date of permanent storm water and erosion control structures constructed.
   4. Date of final completion of project.

E. Temporary and Permanent control measures and facilities
   1. Types of permanent and temporary measures.
   2. Seeding recommendations
   3. Topsoil stockpile.
   4. Calculations of permanent and temporary measures.

F. Maintenance of Facilities
   1. Who will maintain structure during development.
   2. How long will structure be maintained.

G. Number of Plans
   1. Three copies of the plan.

EFFECTS OF REGULATION ON BUILDING PROCEDURES

James F. Brady, President
Majestic Construction Co.

Builders are not automatically "agin" regulations for the sensible control of land for building purposes. In many cases innovative builders and developers have sensibly and imaginatively developed problem or unusual sites into award winning projects. Today builders and developers recognize the need to provide cost effective controls for erosion and sediment containment. For this reason the National Association of Home Builders in conjunction with the Urban Land Institute and the American Society of Civil Engineers has prepared a series of informational manuals and visuals dealing with performance standards for various infrastructural elements in residential developement. These studies discuss the objectives, principles and design considerations to be applied to the developement process. Hopefully, these will be used by developers, planners, engineers and municipal officials.

The slide presentation titled "Erosion and Sediment Control" was shown. For brevity the prepared tape was omitted. See Precis - Schedule A.

This preparation of this visual and tape is a recognition by the building community of the need to participate in the formulation of cost effective land developement controls. Its very basic approach makes it ideal for use with all levels of public and quasi-public groups, particularly when in the process of considering legislative action on controls.

The effects of excessive regulation on building procedures are reflected in today's dramatically spiralling costs. The typical reaction to this fact is that higher costs just means lower builder profits. This is not the problem. The problem is that the true impact of excessive costs is to substantially reduce the total housing market. It is in large part the "entry" housing market - those buying their first home - that is most adversely affected by costly environmental restrictions. Most entry housing is created in large scale developements, the major consumers of residential acreage. These are the tracts which usually require the most sensitive and sophisticated developement techniques. At the same time they are the tracts most likely to be delayed as the developement plan becomes mired in a series of submissions to control groups at local, county and state levels. Sensible controls, yes, but not the proliferation of regulations and restrictions from planning groups at cross purposes.

Between 1970 and 1976 the price of new homes increased 90%; land and land developement costs comprised a disproportionate share of this increase. In the 1950's about 11% of the cost of a new home was in the lot. In early 1977, 25% was represented by lot cost. Today in most areas it is 30%. The bulk of this increase is reflective of continually increasing standards and excessive regulations. Bonding becomes increasingly onerous. Bonds are almost impossible to obtain, very expensive and it is difficult to obtain releases. With the increasing use of retention ponds in smaller and smaller developements the question of maintenance becomes a large problem for all concerned, the residents, the builder and the community - who foots the cost?

The biggest factor in land developement, particularly in matters affected by environmental controls, is the time required for submissions and approvals. The ninety day subdivision approval is dead. Instead eighteen months to two years is the norm. Ground owned or under option continues to accumulate costs during the processing period. Technical staffs are needed to procure data, produce reports and prepare plans for all levels of the submission process. As "208" and "201", coupled with local and state plans come on stream more delays and preparation costs are inevitable. A recent study by HUD stated clearly that excessive controls and processing were a big part of housing costs. NAHB recently commissioned a model subdivision study: some of the findings showed differences in street costs nationwide ranging from $311 to $1435 per lot, sanitary sewers from $358 to $1497, erosion control from $4 to $411, and developement fees from $4 to $2302 per lot. Granted geography, climate and soil account for a portion of the difference: but the conclusion must be drawn that locally mandated regulations create excessive costs and can be a big factor in the market place.

I would suggest that the biggest obstacle to effective erosion and sediment control lies in local zoning ordinances. In our area the half-acre lot is king, regardless of topography or soil conditions. It is almost impossible to obtain approval for any other kind of developement. As the easy sites are used, the developer must turn to the more difficult sites that have been passed over. In our area this generally means hillsides, and hillsides mean bigger soil control problems. How much more effective our mutual job of minimizing erosion and sedimentation would be if we could cluster and zero lot line our housing.

There are some areas that have done this and most effectively. But in those areas where planned unit developement is not prevalent it seems to me the most effective controls could be achieved by your working with the planning commissions and city councils and county commissioners to promote flexible land use patterns. Provide them with your data and studies; not just to put on new controls but to develope land use systems that would provide for the best possible use of the land and to minimize controls.

Even in the areas where PUD ordinances are on the books public hearings are often necessary for plan approval. Having stood before many a planning commission outnumbered 50 to 1 it would be most helpful (and refreshing) to have someone not on the developer's payroll testify that a cluster of homes would be the best way to preserve the trees and streams.

The developer and the soil and water conservationist should not have to have an adversary relationship. We should share a common goal by working together to protect the land while providing housing for all our people.

Schedule A - Precis of Tape

Shown first are the conditions of the Thirties through the post war boom. In the Sixties the need for controls became apparent. While controls are needed erosion has always been part of the natural process. Farming produces 4 Billion tons of sediment annually. While construction produces far less its impact on smaller areas is more intensive. Total rainfall, soil porosity, geography and climate are all factors in erosion. Job control, timing and site preparation and utilization are all part of a sensible developement program.

EROSION CONTROL AND STORM WATER MANAGEMENT FOR URBAN SOIL SEDIMENT POLLUTION ABATEMENT
A WORKABLE OHIO STANDARD

Robert L. Goettemoeller
Deputy Chief, Pollution Abatement
Division of Soil and Water Districts
Ohio Department of Natural Resources
Fountain Square, Columbus, Ohio 43224

Soil erosion on urban development construction sites and uncontrolled accelerated storm water runoff from developed urban areas are the roots of urban soil sediment pollution. Damage from accelerated urban erosion and resulting sediment pollution is immediate as well as far reaching and very expensive to repair. Eroded development sites must be regraded and sometimes resoiled to establish a desirable stand of vegetative cover. Sediment must be removed from culverts and storm sewers at an unnecessary cost passed on to the eventual land or home buyer.

Damage to water quality from urban sediment pollution is generally considered significant but difficult to fix an accurate cost to. Downstream damage to aquatic life, water treatment costs, and so on are difficult to identify in terms of the increase caused by accelerated erosion.

The most dramatic and costly damage occurs off the development site in the way of accelerated stream channel and flood plain erosion and sediment deposition in storm drainage facilities, rivers, lakes, and shipping harbors. Past philosophy sought maximum convenience at an individual site by the most rapid possible elimination of excess surface water after a rain. The cumulative effects of such approaches have been a major cause of accelerated downstream channel erosion and increased frequency and level of flooding. In some cases, the effects have necessitated development of massive engineering works to prevent channel erosion and flood damages at public expense or at the expense of innocent downstream property owners. The cost of removing and disposal of sediment from streams, lakes, and harbors is skyrocketing. Costs have reached eight to ten dollars a cubic yard in some cases due primarily to transportation costs for disposal of dredged material.

Water quality standards provide very little guidance where those responsible for the pollution do not have control of one or more of the major elements which cause the problem. The unpredictable, uncontrollable aspects of precipitation - form, timing, intensity, duration - are the significant factors in soil erosion/sediment pollution which the landowner, planner, developer, or contractor cannot control. In spite of the action of the contractor, for example, significant erosion and offsite deposition may occur due to an intense, untimely rainfall event.

The challenge and perhaps the obligation is to develop and apply a reasonable and workable standard, one which allows the developer to know what is expected, what he must do before the first spade of earth is turned. The developer must be able to use the standard to plan and apply the needed control practice.

In Ohio, standards to address urban sediment pollution are expressed in terms of a level of conservation or management to be applied in conjunction with earth grading, filling, excavating, or other earth disturbance on development areas rather than a level of water quality expected. The owner, or developer, applies the appropriate level of conservation, sediment control, and water management practices in conjunction with earth disturbance on development sites and any soil material eroded from a site with the practices in place, is considered acceptable with respect to the standards. Ohio's standards deal separately with development site erosion and with off-site stream channel and flood plain erosion resulting from accelerated storm water runoff from developed areas.

Maintaining the productivity of the land is not vitally important on urban develop land as compared to agricultural land. Two options, therefore, are allowed in the case of development site erosion. Erosion can be controlled on the site or it can be allowed to occur if the sediment is filtered from or settled out of the runoff water before it leaves the development site. The standards, then, relate to the level of conservation practices required, or the size of settling area required.

Ohio's standard for sheet and rill erosion control on urban development areas states: the person responsible shall:

A. Construct and maintain sediment basins sized in accordance with the United States Soil Conservation Service handbook, "Water Management and Sediment Control for Urbanizing Areas".
B. Apply and maintain a level of management and conservation practices such that the predicted average annual soil loss, accumulative monthly in accordance with the procedure (Universal Soil Loss Equation) in the handbook, "Water Management and Sediment Control for Urbanizing Areas" is less than fifteen tons per acre the first year commencing from the time of initial earth disturbance, ten tons per acre the second year, and five tons per acre for any other year of the development process.
C. Use other methods to control sediment pollution, including, but not limited to, a combination of paragraphs (A) and (B), provided those methods are acceptable to the approving agency.

The developer or erosion control plan consultant should be able to use the "Handbook" to plan an acceptable level of practices for either alternative (A) or (B). In (B), he chooses from a menu of alternative practices using the Universal Soil Loss Equation to select the proper level of practices. Such practices include: limiting time of exposure, temporary seeding and/or mulch cover, permanent revegetation, diversions, limiting the amount of exposed area, and others.

Some judgment is required on the part of the developers as well as the approving agency when using (C). This is true especially when a combination of practices and a sediment basin is used to control sediment pollution on the same area. For example, the "Handbook" might indicate limiting exposure time to two months to keep the predicted average annual soil loss within the fifteen ton tolerable level. The developer knows that exposure time will be six months and therefore plans a sediment basin in combination with a six month exposure time. The approving agency will need to agree to the combination by common sense type judgment. If, on the other hand, part of the exposed area is protected with conservation practices, and pollution from another slope within the same development area is controlled by use of a sediment basin, then the approving agency just checks the practices chosen with the respective criteria in the "Handbook".

The required judgment aspect could possibly be reduced when a combination of (A) and (B) are used, if it would be possible to calculate the effectiveness of a sediment basin in terms of the percentage of sediment removed. This would allow the use of the "Universal Soil Loss Equation" to determine the predicted soil loss and a percentage reduction factor related to a certain size sediment basin to determine how much the predicted soil loss could be reduced. The final predicted loss, after settling, would then be compared with the soil loss tolerance (fifteen tons) to determine acceptability. Until a method can be developed for determining the effectiveness of sediment basins and adopted for use in Ohio, the judgment aspect will need to be used.

A permissable velocity standard is used in Ohio for dealing with concentrated water erosion. It simply requires that flow channels be designed and constructed so that erosion does not occur under flow conditions for the design storm. This takes into consideration the soil type, the kind of channel lining (bare channel, vegetative cover, rip-rap, etc.), channel gradient, runoff area, and so on.

An alternative again allows erosion to occur if a sediment basin, designed in accordance with the "Handbook", is used. A third alternative allows a combination of the two practices.

We also have a standard in Ohio which deals with the sloughing, landsliding, and dumping of earth material. It essentially prohibits the dumping or placing of earth material into public waters (waters in rivers, streams, lakes, or leaving the development area) or into such proximity that it may readily slough, slide, or erode into public waters. An exception is made where dumping or placing is authorized by the approving agency for such purposes as constructing bridges, culverts, erosion control structures, and other in-stream or channel bank improvement works.

The landsliding part of this standard requires the responsible person to employ qualified engineering assistance to explore the stability problems and make recommendations to correct, eliminate, or adequately address the problems before grading, excavating, filling, or imposing a load upon any soil or slope known to be prone to slipping or landsliding. Construction is permitted to commence only after the approving agency has reviewed and approved the exploratory work and recommendations and only in accordance with the approved recommendations. Landsliding is a serious problem in ten or fifteen counties in Ohio, and the soils prone to landsliding are quite well known in those counties.

The downstream channel and flood plain erosion problems and accelerated flooding problems have become nearly catastrophic during the past thirty years as suburban development and its associated commercial development have flourished. Water, formerly stored temporarily in roadside ditches and swales, along with rooftop, sidewalk, driveway, and parking lot water, is now rapidly discharged to the streams and rivers through a supposedly efficient system of street curbs, gutters and massive storm sewers. The most serious downstream damage caused by this accelerated discharge of storm water, generally occurs in the smaller streams. This is related to the percentage of the particular watershed which is developed and the intensity of the development, and the percentage of impervious surface. A fifty acre shopping center parking lot complex, for example, with immediate storm water discharge, could seriously damage a small stream channel having only a couple hundred acre watershed. The same development complex would do an insignificant amount of damage to a large river having thousands of acres within its watershed.

Accelerated storm runoff related problems sort of sneak up on the medium sized streams because their watersheds are developed gradually over a period of years. These streams gradually, and sometimes almost unnoticeably, resize themselves to accommodate the new runoff pattern. Likewise, increased downstream flooding, both in size and frequency, may occur so gradually that the streamside farmer may think it just rains harder and more often. Sooner or later he finds that he can no longer justify growing a crop due to the frequency of flooding.

Correction of the unfortunate results of past urbanization often requires enormous structural works at space age costs. Where such projects are not feasible or public monies are unavailable, property values decline and sometimes lead to abandonment. These problems are a real concern to community leaders unless they are located high and dry at the upper end of a watershed with no legal or moral conviction to consider the damage to downstream property owners.

Several recent court cases set somewhat of a new precedent in Ohio in relation to downstream property damage caused by accelerated storm water runoff. The most significant case found a village liable and legally responsible for downstream damage over an eleven year period, due to the fact that it issued an industrial construction permit without proper guidance and requirements for storm water management.

An extensive effort was set forth in Ohio several years ago to develop standards and criteria to address the problem of accelerated storm water runoff. Committees included representatives from county and municipal government, the development industry, state and federal natural resource management agencies, the professional and consulting engineering organizations, the scientific and research communities, and other interested groups. The standards and criteria are now starting to receive widespread attention and many communities are adopting it as their own controlling criteria.

Accelerated channel erosion and increased flooding and flood plain erosion result from changes in storm water runoff such as an increase in peak, volume, duration, or frequency of runoff, or a decrease in sediment concentration of the runoff waters entering channels. Increased channel erosion from cleaner water coming from a completely developed community results from the greater ability of the cleaner water to carry sediment out of the channel - from the channel banks and stream bed.

Accelerated channel erosion as well as increased flooding damage, could be controlled if the predevelopment hydrograph could be maintained. It is usually not practical, however, to retain the predevelopment rate of infiltration when a large part of the watershed is covered with impervious surfaces. The concept of reducing peak flows below those of predevelopment storms was developed as an alternative to maintaining the predevelopment hydrograph. The logic of this concept is to compensate for the increased erosiveness of:

(1) increased volume of runoff due to less infiltration,
(2) more frequent occurrences of the same flow. For example, a subdivision may have the peak flow of a predevelopment five-year storm occur once a year after development is complete.
(3) less sediment in the runoff water because the watershed is paved with non erosive surfaces or good grass cover.

The two step standard requires that:

A. The peak rates of runoff from an area after development shall be no greater than the peak rates of runoff from the same area before development for all twenty-four-hour storms from one- to one-hundred-year frequency. Designing for the one-, two-, five-, ten-, twenty-five-, fifty-, and one-hundred-year storms is considered adequate to meet the requirement.
B. If the volume of runoff from an area after development will be greater than the volume of runoff from the same area before development, it shall be compensated by reducing the peak rate of runoff from the critical storm and all more frequent storms occurring on the development area to the peak rate of runoff from a one-year frequency, twenty-four-hour storm occurring on the same area under predevelopment conditions. Storms of less frequent occurrence (longer return periods) than the critical storm up to the one-hundred-year storm, shall have peak runoff rates no greater than the peak runoff rates from equivalent size storms under predevelopment conditions.

The critical storm for a specific development area is determined as follows:

(a) Determine the total volume of runoff from a one-year frequency, twenty-four-hour storm, occurring on the development area before and after development.

(b) From the volumes determined in (a), determine the percent of increase in volume of runoff due to development and using this percentage, select the twenty-four-hour critical storm from this table:

If the percentage of increase in volume or runoff is:		The twenty-four-hour "critical storm" for discharge limitation will be:
Equal to or greater than	and less than	
0	10	1 year
10	20	2 year
20	50	5 year
50	100	10 year
100	250	25 year
250	500	50 year
500	---	100 year

This standard basically requires peak flow to be reduced in proportion to increased runoff volume. If runoff volume is not increased, peak flows are only required to match predevelopment peak runoff rates for equivalent size storms. This criteria is designed to require more control when the change in the runoff pattern caused by development is more drastic. The quantity and cost of preventative control features will need to be in proportion to the level of increase in runoff caused by the change in land use - a fair and equitable criterion.

Concern is frequently expressed in regard to the extremes of the accelerated storm water control standard - the one- and the one-hundred-year frequency storms. Justification for using the one-year storm is based on the erosivity of stream flow and on what is known as the "routing problem". Small or frequent storms are very erosive simply because they occur so often. Damage doesn't have time to heal before the next storm comes. Bankfull channel flow is essentially the most erodible state of stream flow on the channel itself. Any increase spills out over the flood plain with very little increase in the velocity of channel flow. Any flow less than bankfull generally has a corresponding decrease in velocity, and therefore, less erosion damage to the channel. Where there is a significant increase in runoff volume, it is very important to have the runoff occur at something less than bankfull flow, especially in watersheds approaching complete development. Longer duration of bankfull flow than that which occurred under predevelopment conditions, can have disastrous effects on the stream channel and resulting sediment pollution. Since channels generally size themselves for about a one and one-half to a two-year frequency storm runoff event, the one-year storm was chosen as the control storm to prevent significant channel erosion.

The "routing problem" is the problem of channel flow downstream from numerous smaller watersheds. As runoff from the smaller watersheds is altered, the effect on channel flow somewhere downstream where all of the watersheds come together, can be favorable or adverse. Ideally, the entire large watershed should be hydraulically planned and the level of control of each sub-watershed should be based on the accummulative effects downstream. Since experience has proven the near impossibility, politically, of realizing that degree of organizational control, the one-year outlet rate is further justified in order to minimize adverse effects on the "routing problem" when compensation is necessary to control increased flow volumes.

Many people suppose that runoff peaks and volumes do not increase from the large or infrequent storm because the ground is saturated by these storms and most of the rainfall will run off whether the land is used for forest land, cropland, or urban purposes. Urbanization can, in fact, cause an increase in both the peak and volume of runoff. Most of the increase may be in the early part of such a storm and perhaps the twenty-five or fifty-year storm control may adequately address the situation. There are many variables which affect the stormwater runoff pattern - soil type, slope, kind of cover, percent impervious cover, kind of disturbance and compaction. The one-hundred year storm needs to be examined in a development situation to determine its specific effect. Emergency flow areas and emergency outlets from structural works need to account for such storms anyway if we don't want basements full of water and structures failing. The additional control necessary for the one-hundred-year frequency storm is not a highly significant factor in storm water management for accelerated runoff control.

In addition to controlling channel erosion, this standard should make long range planning for stormwater management easier. Storm sewers and stream channels can be designed in accordance with existing runoff conditions knowing that upstream runoff rates cannot be increased. This standard would also prevent an increase in flood levels and frequencies below future developments and, in many cases, reduce development costs because of reduced storm sewer size, particularly where multiple use detention facilities can be utilized in designated open space.

A uniform method for determining runoff would be helpful in designing to meet this standard. Not all of the commonly used methods are appropriate. We are currently recommending the U.S. Soil Conservation Service procedures in Technical Release No. 55 which consider watershed area, watershed shape, change in land use, soil type, hydrologic condition, impervious area, modification of hydraulic channels, increased intensity of rainfall near the middle of a storm, initial abstraction (surface storage, interception. and infiltration prior to runoff), and decreased infiltration as a storm progresses. Any acceptable method for determining runoff will have to be able to develop a hydrograph for farm land, forest land, and developed land.

Some of the methods for controlling increases in stormwater runoff peaks and volumes are:

(1) Retarding flow velocities by increasing friction; for example, grassed road ditches rather than paved street

gutters, where practical, discharging roof water to vegetated areas, or grass and rock lined drainage channels.

(2) Grading and use of grade control structures to provide a level of control in flow paths and stream gradients.

(3) Induced infiltration of increased stormwater runoff into the soil where practical; for example, constructing special infiltration areas where soils are suitable, retaining topsoil for all areas to be vegetated, or providing good infiltration areas with proper emergency overflow facilities.

(4) Provisions for detention and retention; for example, permanent ponds and lakes with stormwater basins provided with proper drainage, multiple use areas for stormwater detention and recreation, wildlife, or transportation, or subsurface storage areas.

Maintenance of storm water management facilities, especially those facilities for controlling accelerated runoff are a real concern to the communities where such facilities exist or are proposed. The concern centers, not so much around what must be done and who will do it, but on who will pay for it. Access is needed and it must be protected by easement if the governmental entities are to maintain the facilities. Emergency flow areas must be protected and maintained for their intended purpose. When accelerated runoff control features are intended solely to prevent problems caused by increased runoff from new development, the owners of that new development property should be responsible for maintenance costs. The collection procedure for as needed maintenance assessments is established in Ohio's drainage laws. It has worked quite well for maintaining drainage streams in rural areas and it can probably work in urbanizing areas where the maintenance cost is to be borne by new development property owners. The most ideal situation is perhaps to build facilities which can basically be both maintained and utilized (within limitations of the intent and purpose) by the property owners with the authority and financial means for the governmental entity to do the maintenance if the property owner does not or cannot do it.

Ohio's urban sediment pollution abatement program recommends counties and municipalities to adopt control programs which require sediment control and stormwater management plans to be submitted for approval on all development areas larger than five acres. Smaller development or earth disturbance areas should be required to meet the standards but no prior plan approval would be necessary. Non compliance would be determined by spot checking and citizen surveillance on the smaller development areas.

A reasonable level of soil conservation and water management will provide a reasonable level of sediment pollution control. It will not stop sediment pollution; but then who expects to stop sediment pollution? George Bagley, a Louisiana farmer and former president of the National Association of Conservation Districts, once said at an Ohio Soil and Water Conservation District Association annual meeting, "Thank heavens for erosion or there wouldn't be any Louisiana!". Erosion has always occurred and it always will. Ohio's standards are intended to control the man induced, accelerated portion of erosion and sediment pollution.

THE ROLE OF THE FRONTIER CONSERVATION DISTRICT IN EFFECTIVE EROSION AND SEDIMENTATION CONTROL DURING DEVELOPMENT

Norman Holmes
Frontier Conservation District
Cheyenne, Wyoming

Frontier Conservation District was first organized in the middle nineteen sixties primarily to help the ranching and farming community prevent and reduce erosion on grazing and farming lands. In the later nineteen sixties it was recognized by the supervisors and the district conservationist that developing community was not doing their share in conserving our soil and water resources.

The District then prepared a booklet outlining the resources of Laramie County, Wyoming. Frontier District covers about one-half of Laramie County and has the largest population of any conservation district in Wyoming, including the Capital City of Cheyenne. Our Board of Supervisors consists of a school teacher, land appraiser, and three ranchers.

A note here on the philosophy and political realities of this area is in order. Wyoming people were and still are very conservative. Wyoming is basically an agricultural state and does not generally like some bureaucrat promulgating rules which do not make sense and are impossible to live with. We generally do not like "big brother" looking over our shoulder.

This booklet previously mentioned was prepared and copies were made available to everyone. This was a first attempt to get a working relationship with developers. At that time there was a city planning commission and a county planning commission. In the early seventies the planning commissions were combined into a joint Cheyenne-Laramie County Regional Planning Commission. There was a one person planning staff at that time.

Our district, through our district conservationist, started assisting the planning office about areas of soil and water erosion. This was in an unofficial status. At that time, one of the district's supervisors was appointed to the planning commission. He was then able to influence the outcome of the planning commission's recommendations by his vote and had influence on his peer commissioners.

When areas were to be developed he suggested to the developers that they contact Frontier District for technical help on erosion and sedimentation before platting. The help was free and so the word spread that technical help was free and the technical recommendations were practical and in most cases the cost of doing the work to reduce erosion and sedimentation was minimal.

In 1975 a new supervisor was elected to the board that was also a member of the planning commission. With two members of the planning commission concerned with using our resources wisely, including doing everything practical to reduce erosion and sedimentation, the developers found it was much easier to do things right than to fight with the planning commission.

In 1976 the Wyoming Legislature passed several environmental acts including a State Land Use Plan. This act was essentially an attempt to get the local governments to do something about the helter-skelter development that was happening state wide. Laramie County then actually started to do some planning rather than approve any development that was put forth.

Frontier District forseeing the approach of rapid development had asked for and got money from the Laramie County Commissioners to intensify soil surveys in areas near Cheyenne. Because of this and Frontier District having much more knowledge of the county proper than any other county agency, they were asked for their input into the county land use plan.

Frontier District furnished the soil data, the terrain data, and the land use data for the county land use plan.

In the meantime, a new state subdivision act was passed and in it the conservation's districts were to report on soil and surface water suitability for new developments. The county also wrote new subdivision regulations and Frontier District became one of the agencies that reviewed preliminary plats. They are to review plats for soil and surface water suitabilities and hazards.

Our reviews are made by our technicians and approved by the board of supervisors. Our comments are sent to the planning office where they are assembled with the comments of the other reviewing agencies and presented to the planning commission and the board of commissioners. A negative review by the district does not mean that the development will be stopped, but generally it is easier for the developer to comply to rather than fight with the planning commission.

Our District Conservationist has bent over backwards to assist developers and the word has got around. He assisted in preliminary design on what will become the largest development in this region. This design included mapping all known or all possible water, soil, or slope hazards, and his recommendation on what to do with these areas. He has done this on numerous others and this is at no cost to the developers.

Frontier District has many ranchette type developments in it. Many of these tracts contain not only a home, well, and septic system, but also an over-abundance of horses. Many of these acreages were becoming devoid of vegetation and soil was being lost through wind erosion, so

Frontier District printed a small pamphlet entitled, "Horse Sense and Grass Facts". This pamphlet has been dispersed through the community and most people are now doing a better job of maintaining an adequate grass cover on their lots. We feel this approach has done more good than a new county ordinance because the ordinance would have been nearly impossible to pass from a political standpoint and impossible to enforce from an enforcement approach. This pamphlet was so well received that we have had requests for it nationwide.

The joint city-county planning office has no expertise "in house" for slope evaluation, erosion control, or soil engineering, so we are now inspecting each site in conjunction with planning office personnel. You might say that we are not only assisting them, but also training them in the types of problems to look for in site evaluations.

The city engineer now recommends to developers that have not contacted the Frontier Conservation District and that could have serious erosion and sedimentation problems to contact us.

Several years ago we put together a set of slides showing the problems of erosion and sedimentation during development that has been shown throughout the community to civic groups and political leaders. This has helped us to get community pressure on developers and agencies that are responsible for quality development. Our district will show this to any group and we have probably shown it to seventy-five percent of the people involved in the decision-making process affecting development.

Annually, we hold a luncheon for our sixteen state legislative representatives about a month before legislature convenes. We explain to them what we have done in the past year and present our work program for the future year. This enables us to visit with them on a one- to-one basis and to get to know them personally. Since we are partially funded by the state as are all of the conservation districts in Wyoming, it helps the legislators to know how the taxpayer's money is being spent. It also gives them a place to go for specific information concerning conservation. It also gives us some powerful political allies. We also run a conservation education program each fall for teachers which carries two hours of college credit.

We also visit at least once annually in a formal meeting with the Board of County Commissioners who have the final say in matters concerning erosion and sedimentation during land development. We try to show where we have helped to reduce these problems and point out where more could be done. We also have a good informal relationship with them, especially now that one of our supervisors is married to a commissioner.

This is how Frontier District has approached the problems of erosion and sedimentation during development. We feel that considering the political climate; the problems involved and types of development, from urbanization to ranchettes, that we have done an excellent job. We have not solved all of the problems, but we are getting there. Laramie County and Cheyenne have come from ignoring sedimentation and erosion, unless there was an immediate cost to the developer, to now trying to design developments so that no immediate or future erosion or sedimentation will result. Developers are now aware that the least total cost is trying to design out all immediate and future problems in this area resulting in less total cost to them and the taxpayer.

This is how we handle it and I hope some of our ideas will be beneficial to you.

SELF-REGULATION, ALTERNATIVE TO LEGISLATION
WAUKESHA COUNTY, WISCONSIN

Richard L. Mace
Assistant Planning Director
Waukesha County Park & Planning Commission

There are probably any number of reasons why the urban - suburban run-off problem has gained in its recognition over the past years in Waukesha County, which is a rapidly expanding County immediately west and adjacent to Milwaukee County in southeastern Wisconsin. The pressures for land development have been severe since the early 1950's. Waukesha County is the fastest growing county in the State of Wisconsin and has been for a number of years, and is likely to remain so in the future due to its close proximity to Milwaukee and the large industrial/commercial base existing in the region and the good transportation network for shipping in and out of the region via the railroads, highways and the Great Lakes. As a result of this surge in development in surrounding areas around Milwaukee County, a very good network of roads and freeways has developed as a result of this new development which has encouraged suburban residential uses in the fringe areas such as Waukesha County. In addition, the County has a very attractive natural setting with a wide variety of landform features including the well known Kettle Moraine region with its kettles and rivers and hills and woods, and most important, its lakes. The urban - suburban run-off problem has always been present but has not gained in recognition until only recently as there became an increased citizen and governmental awareness of the environmental problem created by increased surface water runoff from these new developments. While these areas were being developed there were severe economic pressures to maximize the land use and density of development without regard for the implications of storm water runoff. It was originally important to plan, design and implement a system of servicing these newly developed areas with roads, highways and storm drainage systems designed to provide a minimum standard for servicing the area with little or no attention being paid to the effect those systems had on both upstream and downstream watershed areas. Very little consideration was given to future stormwater flows within those developed areas. Planners and zoning officials were concerned only with the development of subdivisions and other commercial industrial developments and gave little recognition or attention to the environmental impacts of the development upon the watershed. It seemed that the philosophy was to encourage growth, and design the development so as to remove storm water as quickly as possible with no effort to retain or control the rate of stormwater flows. As the developments encroached further and further into the agricultural community, more and more farmers and land owners adjacent to these developing areas became concerned and brought to the attention of our office and the Waukesha County Soil & Water Conservation District the need for greater exercise of control over the development of these subdivisions, especially as it related to the control of stormwater runoff.

Because of this increased awareness and our concern for preserving and protecting the environment in which we live, the District Conservationist and I felt that it would be a good idea to conduct a tour of Waukesha County especially for the Waukesha County Soil & Water Conservation District

Supervisors to be held July 21, 1976. Because of the success of that tour, a second tour for County Board Members and Municipal Officials to acquaint them with the problems and examples of poor development within our County was arranged rather than conduct a tour and show them all the nice parks and other good things about the County. This had never been done and we were somewhat skeptical and concerned with the reception it would receive especially when we pointed out problem areas and examples of poor development. On August 31, 1976, the second tour was conducted with the help of the County Extension Agent, the local Soil and Water Conservation District Conservationist and myself. The purpose of the tour was primarily to show those in attendance the problems we were having with new subdivisions and their impact on adjacent lands and the effect those subdivisions had specifically with regard to soil erosion and sedimentation both within the subdivision and in the areas immediately surrounding it. The tour was extremely successful and received much attention from the local newspapers including both the Milwaukee Journal and Sentinel. It has been talked about on any number of occasions since that time.

We are presently in the process of planning another tour to be conducted on October 22nd of this year to acquaint the same officials with the problems we are having with solid waste and to make them aware of the severe crisis we are facing with the closure by 1982 of all of the County landfills, except one. Because of the experience gained from the subdivision tour, we felt that another tour was in order to increase County officials awareness of the problem and hopefully encourage them to react positively with the necessary legislation to bring an end to the crisis.

Getting back to the surface water runoff problem, the Soil and Water Conservation District, in March, 1977, adopted a number of guidelines and objectives which they have been working towards in the past two years. One of those objectives was to promote and encourage the development of drainage and/or resource plans prepared by developers for new developments and to encourage adoption of County wide ordinances regarding drainage plans with enforcement to be the responsibility of the County Park and Planning Commission, and review and recommendations by the Soil and Water Conservation District. Enforcement responsibility was placed in the hands of the Park and Planning Commission due to the fact that the State Statutes provide for plat review authority by that agency rather than the Soil and Water Conservation District. However, a second objective was that the Soil and Water Conservation District in cooperation with the Park and Planning Commission, would develop a set of guidelines for developers to use in preparing a conservation plan for subdivisions. A third objective was to promote, encourage and provide technical assistance to local County and State Highway Departments to utilize Waukesha County Conservation Standards in the development and maintenance of roadside ditches. There were other guidelines established in that 1977 meeting more numerous than necessary to mention in this presentation.

Since the formulation of those objectives, the Soil and Water Conservation District and the Park and Planning Commission have been working very closely together to implement those objectives. With reference to the subdivision developments, it is required by the Statute that a preliminary plat indicating the overall design of roads and lots ~~is to~~ be submitted to the County as well as other agencies for review and approval with varying degrees of authority. Since the formulation of the objectives, the Park and Planning Commission has been requiring the preparation of drainage and erosion control plans to be prepared by the developers and submitted to the Park and Planning Commission and subsequently to the Soil and Water Conservation District Supervisors for their review and comment. It should be noted that the Soil and Water Conservation District has adopted the Soil Conservation Service Technical Guide as the Waukesha County Soil and Water Conservation District's standards and specifications. All subdivision plats in the County, except those where storm sewers are provided, are reviewed on the basis of the Technical Guide. Consulting Engineers and Surveyors have been informed of the requirements by letter from our office and for the most part have been utilizing these standards when they design their drainage and erosion control plans. It should be noted that an ordinance has not been adopted specifically to effectuate the requirements for drainage and erosion control plans. The Commission has determined that in the absence of specific enabling legislation being established in the Statutes for their review of subdivisions, it is in the public's interest in the review of subdivision developments to provide for the control of erosion and sedimentation. Because of the lack of a specific ordinance implementing these requirements, there are still a few engineers and surveyors who are not cooperating but on the average most surveyors and engineers recognize the need to provide for erosion and sediment control especially since all of the publicity has come out with regard to the 208 water quality planning effort and the concern for the protection of our natural resources. It should also be noted that a set of guidelines has been developed and distributed to all engineers and surveyors working in the County.

The Soil and Water Conservation District receives the plan, they review it, keeping in mind all the alternatives, and do not hold hard and fast to one alternative method for accomplishing erosion and sediment control. The District Conservationist makes at least one on site inspection of the subdivision prior to presenting his recommendation to the District Supervisors and subsequently provides a written recommendation to the supervisors who will in turn either adopt or reject his recommendations and accordingly the plan. If the plan is rejected, the Commission will ask that the consultant revise the plan in order to bring it up to standards which will be acceptable with the Soil and Water Conservation District. It should be noted, however, that the longer we work with this process, the more complete and conforming the plans have become with respect to our County standards, and in large part usually receive good recommendations after the first submittal of the plats. Over the past couple of years the plans being submitted have improved tremendously, especially since the preparation of the guidelines indicating specifically what the plans should provide.

A factor which I think has contributed to the success of this program is that the consultants working in the County have a very good working relationship with the staff of the Park and Planning Commission as a result of the great amount of development which has occurred in the County and the tenure of the staff and I feel that this has contributed a great deal to the success of our program. The program is not without its problems, however. Because of the lack of an ordinance specifically setting forth the rules and regulations, the possibility of a legal challenge does exist with respect to enforcement of these guidelines, although to date no such threat has presented itself. I feel that the primary reason for this lack of a challenge is that the subdividers are anxious to cooperate in an effort to make available as quickly as possible their lots for sale in order to recuperate their expenses and for that reason are willing to cooperate to the greatest extent possible and are not able to afford a legal challenge because of the length of time and the costs of such a challenge. I also believe that after seeing what a good conservation plan and its proper execution will accomplish, many developers have begun to realize that proper erosion and sediment control techniques will enhance the quality and desirability of their product and in the long run will reduce costs. Such cost reductions occur because the subdivider is not required to return to make repairs to inadequately installed or improperly designed facilities. They have learned that doing the job right the first time has built in economies benefiting themselves, the consumer, and the public in general.

Another problem that we are having is the lack of follow up by the consultants. It is absolutely imperative that the consultants follow up with the contractors to ensure that the plans which have been submitted and reviewed are being followed by the contractors. The reason for this problem, I believe, is that there is no remuneration for the follow up by the consultant because the subdivider is trying to get the job accomplished for as little cost as possible, and because of the costs of the follow up, the consultants are not carrying out that function unless it is specifically set forth in their contract with the subdivider.

A third problem that we have more recently become aware of is that the contractor who is doing the erosion and sediment control work is not receiving the same set of plans and specifications which have been submitted and reviewed by our office and the Soil and Water Conservation District. In response to that problem, some of the surveyors have developed bid schedules which specifically include the sediment and erosion control plans and are submitting those bid schedules and specifications to us along with the drainage plans. I also feel that some of the contractors working in this area have not realized the importance of erosion and sediment control in that they had never had to be aware of and provide for such facilities in the past. Because of the change, they are somewhat reluctant to install these facilities or do not know the techniques for their construction and accordingly are neglecting them. We feel that with an educational effort in this area this problem should be minimized in the years to come. In many cases, some of the work which has to be accomplished by contractors is work that can only be done properly by hand and because of the bidding schedules and the fact that they are not familiar with the need for the hand labor, the facilities are not being constructed properly. Accordingly, this lack of execution contributes to increased erosion and sedimentation problems which have to be rectified at a later date with increased cost to the subdivider.

As mentioned above, I feel that an increased educational effort in this direction is necessary and that this problem can be overcome. More recently we have realized that our lack of review in areas where storm sewer systems are provided has resulted in some downstream problems which need our attention. This is probably an oversight on our part which has occurred due to the newness of this entire process. However, we have now recognized this problem and have begun to work on correcting it. We are now aware of the fact that the construction of storm sewers does not necessarily negate the need for surface water facilities in an urbanizing region such as ours where we have a mixture of storm sewers and rural type surface water drainage systems. Where storm sewers exit onto the surface of the ground and not into established stream beds, severe erosion and downstream sedimentation will occur with the increase of flows emanating from storm sewer systems, and it is imperative that we formulate guidelines to adequately protect receiving lands from the adverse effects these storm water systems have on downstream areas.

In summary, we feel that in the absence of an Ordinance specifically providing for the implementation of erosion sediment control plans, our program has been remarkably successful. We feel that a number of things of varying magnitude have contributed to that success:

First, our agency and the Soil and Water Conservation District are located in the same building which provides for good communication and the development of a very good working relationship and the utilization of each others resources.

Secondly, the Soil and Water Conservation District Supervisors and the Park and Planning Commission are all interested in solving this problem of erosion and sediment control and a cooperative spirit between the two departments exists.

Third, we feel that the tour which pointed out a number of problems relative to the subdividing process was extremely successful, especially in acquainting Municipal Officials and the various committees of the County Board, with these problem of development. In addition, the publicity which we received from this tour was very helpful.

Fourth, through our many discussions with subdividers and surveyors on a daily basis, the tenure of the staff has created a good working relationship with the developers and consultants in the County. We feel that these kinds of relationships have contributed to the success of the program through the mutual give and take which occurs during our deliberations with the developers and consultants. This is an educational process and by pointing out the problems and benefits to be gained by providing good erosion and sediment control practices, they have come to realize that their land is more valuable when properly developed. They also realize that if they cooperate in the development of these facilities, that their subdivision plats will be approved and the sale of lots can commence much earlier than if they had not been in that cooperative spirit.

I should also point out that an effort is presently being undertaken to revise the existing Subdivision Control Ordinance in Waukesha County and include a provision for erosion and sediment control to be implemented on a county wide basis. We have provided assistance in the preparation of Ordinances for various communities in our County relative to erosion and sediment control, which have been adopted and implemented and are now being adopted by adjacent communities. We feel that as the idea catches on, other communities will begin to revise their ordinances to provide for such erosion facilities and incorporate them into the subdividing process.

I would like to take this opportunity to thank you for listening to my story and hope that you have benefited in some way. I would be happy to answer any questions you may have about the program or any other aspects of land development and hope that I can provide you with an answer. Thank you, again.

NON-AGRICULTURAL EROSION CONTROL IN IOWA

Lawrence G. Vance
Director, Iowa Department of Soil Conservation
Des Moines, Iowa

On July 1, 1971, a legislative bill entitled "An Act Related to Conservation of Soil and Water Resources of the State" became law in Iowa. It established an erosion control program that preceded PL 92-500 by a full year and became the first erosion control law in the nation.

The bill granted soil conservation districts the authority and responsibility to establish soil loss limit regulations. I emphasize that it granted the responsibility to local soil conservation districts to establish soil loss limits and to enforce them. In Iowa, this means subdivisions of state government whose boundaries are the same as county boundaries, with the exception of one county which has been organized into two soil conservation districts.

Soil loss limits are required for agricultural land and for construction sites. To insure that uniform and reasonable regulations were established, a technical committee at the state level developed a guideline document that set forth annual maximum permissible soil loss rates for the 1,500 soil types classified in Iowa. These rates range from two to five tons per acre per year and are coincident with the replenishment rate of individual soil types. For construction sites, a uniform five tons per acre per year maximum permissible rate was suggested. These uniform regulations were adopted in all 100 soil conservation districts without serious objections. The current regulations provide that an owner or occupant of land damaged by another landowner's sediment may file a complaint with the soil conservation district commissioners. This has stopped many people from filing a complaint. They just can't bring themselves to coming down on their next-door neighbor.

The legislation provided that additional or revised rules and regulations could be developed and adopted. Experience and even public attitude may well dictate, for example, that the soil conservation district commissioners should be empowered to mandate compliance with the soil loss limit regulations even though a landowner has not filed a complaint. After eight years, it appears that we are nearing the time when commissioners will seek the power to act without a written complaint.

Having given you an overview of the total package, I now want to explain more specifically the soil loss limit, as it was adopted in all 100 soil conservation districts.

Agricultural and Horticultural Lands. Maximum rates of soil erosion for these lands are the average annual soil loss expressed in tons per acre per year varying from two to five tons.

Non-Agricultural Lands. Such as public parks, urban lands, industrial parks, airports, public and private recreation lands, roads, streets, highways, railroads, mined lands, and other lands include an average annual soil loss of five tons per acre per year.

Construction Sites. Including housing developments, shopping centers, industrial park developments, commercial building sites, highways, drainage channels, floodways, water impoundment structures, and other similar projects. The maximum rate of soil erosion permitted on such lands is five tons per acre per year leaving the site.

The Iowa law provides that individual landowners, government agencies, or others having interest in property being damaged by sediment from soil erosion on lands other than their own may file a complaint against owners of land on which such erosion is alleged to be occurring. These parties may include but not be limited to one or more of the following: farm owners, city landowners, conservancy districts, Iowa Conservation Commission, county conservation boards, county boards of supervisors, Iowa Department of Transportation, U.S. Corps of Army Engineers, cities and towns, or other special purpose districts.

The commissioners of any soil conservation district shall inspect, or cause to be inspected, any land within the district upon receipt of a written and signed complaint, stating that soil erosion is occurring thereon in excess of the limits established by the district's soil loss regulations. If the commissioners find that excessive soil erosion is occurring on the land inspected, they shall issue an administrative order to the landowner or landowners of record, and to the occupant of the land, describing said land and stating as nearly as possible the extent to which soil erosion thereon exceeds the limits established by the district's regulations. The order shall be delivered either by personal service or by restricted certified mail to each of the persons to whom it is directed.

In the case of erosion occurring on the site of any construction project or similar undertaking involving the removal of all or a major portion of the vegetation or other natural or man-made cover which exposes bare soil directly to water or wind, the order shall state a time not more than five days after service or mailing of the notice of the order when work necessary to establish or maintain erosion control practices must be commenced, and a time not more than 30 days after service or mailing of the notice of the order when the work is to be satisfactorily completed.

It was felt that in non-agricultural erosion, nearly immediate compliance was necessary since massive soil losses can happen in short time periods; and the resulting sediment damage can have a greater economic impact.

State cost-share funds are not provided for non-agricultural erosion control practices since the developer can recover the cost as part of the construction cost. Developers are advised of techniques which can be used to reduce erosion. However, they are not given design assistance since they can employ their own engineer.

In all other cases, such as farmland, the order shall state a time not more than six months after service or mailing of the notice of the order by which work needed to establish or maintain the necessary soil and water conservation practices or erosion control measures must be commenced, and a time not more than one year after the service or mailing of the notice of the order when the work is to be satisfactorily completed. The law stipulates, however, that cost-share assistance must be available and committed to the landowner as a basis for requiring mandatory application of permanent soil and water conservation practices on agricultural and horticultural lands.

In acting upon complaints, soil conservation districts must inspect the lands covered by the complaint to determine (1) that damages are in fact occurring as charged in the complaint, and (2) that erosion is occurring on lands above the point of damage at rates that exceed the regulations of the district. In determining rates of erosion, the "Universal Soil Loss Equation" for water erosion and the formula for wind erosion are used by technicians of the soil conservation district.

If the work is not initiated as required or the landowner advises the district that he does not intend to do the work, the soil conservation district may petition the district court for a court order directing the owner or owners to proceed with work as required by the administrative order. The court order may then be served with the expectation that the work will be completed. Failure to comply with the court order can result in placing the property owner in contempt of court and he can be penalized accordingly.

The punishment for contempt of court in Iowa, as it relates to this law and when the district court has jurisdiction, is a fine not exceeding $500.00, or by imprisonment in a county jail not exceeding six months, or both such fine and imprisonment. The contempt charge could even be more severe, in that if the contempt consists of an omission to perform an act which is yet in the power of the person to perform, he may be imprisoned until he performs it. In that case, the act to be performed must be specified in the warrant of the commitment.

In complaint cases involving agricultural or horticultural land, after cost-share funds have been committed, the district issues a supplemental administrative order advising the owner or owners to proceed with the necessary work, beginning not more than six months following the notice and to be completed one year from date of order. It should be pointed out that before actions mandated in an administrative order can be enforced, the law requires that 75 percent cost-share funds must be provided for any erosion or soil conservation measures on agricultural and horticultural lands.

When the REAP funds were impounded in December of 1972, many people said this would negate the Iowa sediment control law because of the need for cost-sharing funds to make the law workable. Fortunately, in Iowa we have a governor and a legislature that are strong supporters of the soil conservation program; and as a result, since 1973, $29,450,000 has been made available to the Department of Soil Conservation for soil conservation cost-sharing purposes.

I should also point out that the Iowa law has been tested in the courts for its constitutionality. Before the test, attorneys, law professors, and others, who are knowledgeable in constitutional law and the manner in which soil conservation district commissioners are elected, assured soil conservation districts that the law was constitutional. Much of this opinion is based on the fact that any qualified elector in the state of Iowa may serve as a soil conservation district commissioner whether living in a city, town or on a farm; and any qualified elector may vote in a commissioners election. During 1975, the Iowa General Assembly enacted legislation that placed the election of commissioners on a non-partisan ballot in the November general election.

The constitutionality of the law was tested in the courts in 1975. In this case, an agricultural soil loss limit was violated and two landowners were ordered to install terraces or permanent vegetative seedings at a 25 percent cost to them of $13,500. The district court held that the order placed an unreasonable burden on the defendants, and concluded that the defendants were deprived of rights granted in the fifth and fourteenth amendments to the Constitution of the United States and comparable provisions of the State of Iowa. The court held that the law was not constitutional. An appeal was filed with the Iowa Supreme Court. The question of soil loss limits was without dispute. The question of constitutionality was reviewed as to whether the restrictions and conditions imposed by the Iowa Code amounted to taking of property under eminent domain or simply a regulation under the police power of the state. The latter entitles the property owner to no compensation; the former requires that he be paid for the appropriation of his property for public use. The court held it important to consider the nature of the public interest involved and the impact of the restrictions placed on the defendants' use of their land. It stated that the state has a vital interest in protecting its soil as the greatest of its natural resources, and it has a right to do so. While recognizing that the Code imposes an extra financial burden on the defendant, it is one the state has a right to exact. The importance of soil conservation is best illustrated by the state's willingness to pay three-fourths of the cost. The Supreme Court held that a law does not become unconstitutional because it works a hardship. Since the defendants retained the use and enjoyment of their property, limited only by the necessity to prevent erosion beyond allowable standards, the Supreme Court of Iowa reversed the judgment of the district court and on May 30, 1979, upheld the constitutionality of the law. The lower court was directed to proceed with settling the complaint.

I might also add that in 1979 the Iowa legislature passed an amendment to limit the landowner required investment to $10.00 per acre times the acres owned for any one year, in an attempt to alleviate the financial hardship question in the future.

Perhaps a short review of what has taken place, as far as complaints since Iowa instituted soil loss limit regulations, would be of interest.

The number of complaints that have been filed with soil conservation districts has not been excessive. Since initiation of the law in 1972, approximately 550 complaints have been filed. All but 63 were settled voluntarily. Fourteen complaints were in non-agricultural areas--three against highway site erosion and 11 against development sites. Eight of the non-agricultural complaints required administrative orders before they were resolved.

Complaints on non-agricultural erosion have been filed against the Iowa Department of Transportation for permitting sediment to move from road ditches on to private land, against developers permitting sediment to leave the site and fill road ditches and storm sewers and damage property, and against a coal mine operator for permitting sediment to wash on to adjacent farmland. It is interesting to note that the first complaint filed under Iowa's law was against officials of a Little League Baseball diamond in Des Moines. The problem in this instance was that considerable earth work had been done and officials failed to take adequate precautions to retain sediment on the site. As a result, sediment washed on to adjoining lawns and property owners filed a complaint.

In closing, there are some significant points which I would like to emphasize. One is that prior to the time of the enactment of the Iowa erosion control law, many people said that if the law passed, approximately 50 percent of the soil conservation district commissioners in Iowa would resign because they would not want any part in processing complaints filed against people they knew and especially against their friends. This concern did not materialize. Instead, commissioners have accepted the responsibility of administering this law and are doing it in a very fair and equitable manner. They are to be complimented in this regard.

After an official opinion on soil conservation district commissioner tort liability was requested in 1979, we found that for the past 40 years Iowa's commissioners have been without provisions to indemnify themselves. That is, they have not had the ability to pay a judgment in behalf of a commissioner, if they were sued and a judgment rendered. This personal liability caused nervous commissioners; however, we are buying liability insurance now and hope to correct the law in the next session of the legislature.

The law is working, but additional regulations will be required if major abatement of erosion is to occur in the state of Iowa. The inhibiting factor is that a complaint must be filed by owners of property that is being damaged before abatement results. If we are going to correct our sediment problems in the state of Iowa, regulations must be strengthened or a law much stronger will have to be enacted.

We have not found that the two to five ton soil loss is too restrictive. When you realize that if we continue to exceed these erosion rates, the soil resource would eventually be destroyed. The soil loss equation is proving to be adequate for applying Iowa's law. Although some difficulty has been experience in application of the Universal Soil Loss Equation to predict erosion in urban areas, no complaint regarding its use has been received since actual deposition of sediment off site has been reduced satisfactorily. In most cases, our soil loss law serves as a deterrent to obvious violations.

Temporary soil erosion control measures are required as part of building codes in Iowa's larger cities. Many smaller towns and villages do not have such provisions in their codes or ordinances.

We feel that the provisions for non-agricultural erosion control in Iowa's law are satisfactory. We hasten to remind you, however, that Iowa is not experiencing the urban building pressures as many other states are due to our less densely populated state. Iowa's landowners have a good soil conservation ethic, which in most cases rubs off on developers and contractors.

INSTITUTIONAL ANALYSIS OF LOCAL ORDINANCES ADOPTION

W. L. Church
Professor of Law, University of Wisconsin
Madison, Wisconsin

Summary of Remarks

In Wisconsin, under Chapter 92 of the Statutes and other laws, There are three great impediments to attempts by local government to deal with the problems of soil and water conservation and pollution. These include substantive narrowness, geographical constraints and procedural obstacles.

Substantive Narrowness

There is a proliferation of state statutes in Wisconsin authorizing efforts to cope with water pollution. Chapter 92 empowers local governments to deal with soil and water conservation, but it is unfortunately unclear to what degree this may permit local governments to address water pollution problems. The internal ambiguities of Chapter 92 are made worse because there are so many other substantive aspects of the same over-all pollution problems that are dealt with in other statutes, such as sanitation, health, solid waste, zoning, shoreland zoning, building, subdivision, and farmland preservation statutes. The existence of so many entities to deal with the problem makes it much more difficult to state with precision the limits on the authority of any of them and effectively precludes any from dealing confidently with the whole problem. The bureaucracies created at the state level, and the competition and preoccupation with narrow missions thus engendered is often repeated, with variations, down at the county and local level as well, with different local committees, commissions, boards and agencies dealing separately with the various state agencies. The result is a fragmented, confused and ultimately severely limited attempt to deal with water pollution as a whole.

Geographic Constraints

The problem of overlapping and competing substantive missions is compounded locally because there is no one entity with full authority to act throughout a really useful local geographic area. Municipalities have significant reserve authority to act within their boundaries, but they are small and too many to be able to do much for a systematic solution to water pollution problems. Counties may be large enough, but they lack authority to do much in incorporated areas. River basin authorities and other districts measured by natural rather than political boundaries are not fully effective precisely because they lack a recognized political legitimacy and base. In order for a comprehensive approach to water pollution to be undertaken, voluntary cooperation is thus required not only of many sometimes jealously competitive agencies, state and local, but also of many separate municipalities, towns, counties, regional authorities and state agencies. This adds up to too much required cooperation if effective results are realistically to be expected. Experience in the past certainly suggests that the institutions of government thus created will, to some degree, operate to impede rather than to facilitate prompt and decisive action.

Procedural Obstacles

In addition to the problems imposed by the organization of governmental institutions, the Wisconsin Statues, especially Chapter 92, often raise procedural obstacles to progress. Chapter 92 currently, for example, requires a referendum among voters who may be affected by a regulatory ordinance, before such ordinance can be enacted. In practice, this requirement has meant that the regulatory provisions of the chapter cannot be utilized even where a local political establishment is willing to try this. The net result is that much really effective local response to such problems as water pollution is precluded.

Conclusion

Even under the best of conditions, the problems of nonpoint source water pollution and of soil and water conservation, are not going to be easy to deal with. Substantial controversy and delay can be expected before any concensus is reached and expenditures are made and regulations are imposed in an effort to deal with these problems. So the least, a state's statutes should attempt to create local and state institutions of government that will most likely conduce to natural but effective action. The current Wisconsin statutes, especially Chapter 92, do not adequately marshall state or local governmental agencies to cope with the problems on their merits. Accordingly, it appears proper to consider amending Chapter 92 and other state statutes to try to make local government more effective in dealing with non-point source pollution and soil and water conservation. If local government is unable so to deal with these problems, they will be addressed instead by more remote agencies at the state and national level. This would be most unfortunate, both because of the loss of local control over local problems that would be implicit and because the problems themselves would be less likely to be efficiently, rationally resolved.

COMPREHENSIVE COMMUNITY PLANNING AS A PROMISING EROSION CONTROL IMPLEMENTATION TECHNIQUE

Gary Oberts, Senior Environmental Planner
Marcel Jouseau, Natural Resources Program Manager
Metropolitan Council
St. Paul, Minnesota

Introduction

Many erosion control techniques exist to assist communities in their efforts to abate soil loss. Without commitment to a comprehensive land planning and implementation program, experience has shown that poor construction and land development practices continue to be major causes of erosion in urban areas. Isolated or site-by-site reviews of small developing areas without a framework often result in inconsistent reviews and uncoordinated drainage management.

Like many major urban centers, the seven-county Twin Cities Metropolitan Area has experienced extensive suburban growth and urban redevelopment in the last 20 years. Since 1967 the Metropolitan Council has been responsible for preparing regional plans and coordinating regional development. It became apparent that a regional management scheme was needed as a framework for decisions on land management and investment. A regional framework was adopted in 1973. Similarly, in dealing with day-to-day planning matters of the 189 area communities, those who plan comprehensively for erosion control and for management of stormwater runoff are far more effective in solving erosion problems and controling future development options. Unfortunately, few of the 189 communities have adopted a comprehensive erosion/stormwater planning approach, although many authorities are available for use by communities.

Contents of the more successful comprehensive erosion/stormwater plans will be addressed in this paper and emphasis will be placed on the need for strong implementation programs. This paper will discuss the natural resource protection element of a comprehensive plan. Other elements such as housing, parks, transportation, etc. are essential to comprehensive planning, but do not relate to the subject matter discussed here. Technical and administrative information about natural resource protection is available to the governmental units and the developers alike.

Survey Results

Two surveys were conducted within the Metropolitan Area to determine the methods, if any, used to control erosion and stormwater runoff. Surprisingly the results showed that most communities do not have erosion controls and relatively few look beyond the immediate future in stormwater management.

An erosion control ordinance survey was conducted by the Association of Metropolitan Soil and Water Conservation Districts for the Council. A total of 186 local units of government were surveyed with respect to erosion controls applied to land development and the adequacy of the measures. Study results showed that: 100 of the communities have no erosion control and are outside of an organized watershed district that would provide some form of regulatory control; 65 rely solely on the watershed district regulations; and only 21 have adopted their own regulations. All communities, of course, are located within the boundaries of a soil and water conservation district and can voluntarily seek the district's advice on erosion control and ordinance preparation. The percent of adequate treatment for all communities varied from 20 to 90 percent with the average of about 50 percent.

Another survey of 76 communities either experiencing rapid growth or having a history of stormwater-related problems showed that only nine of these communities now have a good stormwater management plan, but several others are preparing such a plan. Again, authorities and techniques exist for communities to develop adequate stormwater plans. Most communities address development projects site-by-site as they are proposed. Variability in local stormwater reviews is so great that few adjacent communities have similar methods and criteria. This often leads to intercommunity disputes.

All the governmental units surveyed have adequate authorities to deal with erosion and stormwater management through community-wide planning and the implementation of controls, but few have exercised these authorities.

Institutions and Their Authorities

In Minnesota, many governmental agencies have enabling authority allowing them to either develop plans for soil conservation and prevention of erosion and sedimentation or to adopt controls to prevent and remedy erosion and sedimentation problems.

o State Agencies. Several state agencies can address erosion concerns: Department of Natural Resources when work is in public waters; Pollution Control Agency if an NPDES permit is required; and the Environmental Quality Board during the review of environmetal disclosure documents (EIS, EAW, etc.), if one is required.

However, the opportunities and authority available at the local level are far greater. Local governments involved are the watershed districts and the soil and water conservation districts (two special-purpose governmental units), and the counties and cities. At the regional level, the Metropolitan Council has an interest and some authority.

o Watershed Districts. These districts are created under Minnesota statutes (M.S.) chapter 112 for the purpose of managing the waters in a watershed. They have the authority to develop a managment plan as well as to issue land alteration permits (M.S.112.36}. There are 10 watershed districts covering approximately one-third of the Metropolitan Area. All of these districts review development projects for erosion and stormwater management. A survey of erosion controls in the Metropolitan Area shows great variations in the effectiveness of these districts.

o Soil and Water Conservation Districts. These are created under M.S.40. Section 40.70 (9) states that they may develop a comprehensive plan spelling-out erosion problems and water quality problem areas. While M.S. 40.02 does not limit concerns to reducing agricultural erosion and sedimentation problems, the past agricultural experience weighs heavily on urban districts which are reluctant to engage in urban erosion control programs. None of these districts has adopted a comprehensive plan. In addition, they do not have regulatory authority and see their role as strictly advisory.

o Counties - The Metropolitan counties, with the exception of Hennepin and Ramsey, have enabling authority to develop comprehensive plans (M.S.394.09) and adopt zoning and other land development controls for unincorporated areas (M.S.394.25). The language in the law specifically includes erosion and sedimentation controls. However, there are great variations among counties in their involvement in planning and zoning.

o Communities - In Minnesota, communities may carry on comprehensive planning activities (M.S.462.353.subd.1.). In the Metropolitan Area, the communities must now prepare a comprehensive plan (1976 session law, ch. 127). The content of a these plans is spelled out in M.S. 473.859 subd. 2 (" Land Use Plan") and M.S. 473.204. This last section specifically addresses erosion and suitability of soil for development. Communities may also regulate the use of land (M.S.462.357) and adopt soil conservation measures and provide for the control of drainage, erosion and siltation (M.S.462.358,subd.2).

o Metropolitan Council: The Metropolitan Council has no regulatory authority. However, it has responsibility for the preparation of regional plans and for coordinating planning. In addition it serves as a regional clearinghouse for projects receiving federal financial assistance; reviews municipal comprehensive plans; and reviews environmental impact disclosure documents. Thus, the Council has substantial means by which to impress upon municipalities the need to prevent soil erosion and sedimentation.

A powerful tool now available to the Council is the Metropolitan Land Planning Act of 1976 (Laws 1976, chapter 127). For the first time, local units of government throughout the Metropolitan Area are required to prepare comprehensive plans which must be submitted to the Council for review. Two elements, among many others, are to be contained in the plans; an environmental element (M.S.473.859.subd.2) and an implementation program (M.S.473.859.subd.4). These elements could be important tools in curbing urban erosion in the Metropolitan Area.

Some of the matters to be included in the environmental element are soil erosion and the suitability of soils for development and drainage (M.S.473.204). The environmental ordinances are to be submitted to the Council for review and comments before their local adoption (M.S.473.206).

The Metropolitan Land Planning Act gives the Council and local units of government a real opportunity to integrate preventive measures for erosion control and stormwater management into the land planning process. However, the success of the Land Planning Act in the environmental area is dependent upon the right mixture of cooperation and coercion because a soil erosion element is not now mandatory in the comprehensive plans.

Why a Comprehensive Planning Approach?

Why then adopt a comprehensive planning approach when there are those who would argue that site-by-site review is quite sufficient to control erosion and manage stormwater? The site-by-site review is valid only within an overall framework. Lack of an overall plan usually results in shortsightedness and problems. Often the lack of relationship between municipally instituted land uses (through planning and zoning) and the land suitability puts an unfair burden on developers who then must justify their use of the site in the face of environmental constraints. As a result, either the developer is successful in convincing the city to eliminate environmental requirements on the basis of impossible constraints or residents get the city to reduce the intensity of use or require environmental impact documents at the cost of the developer and housing prices increase. In any case, someone is losing. Similarly, eagerness to attract development can undo the best erosion control program.

An example of this is a development in the western part of the Twin Cities Area. A landowner has owned 19 acres on a densely wooded, steep-sloped hill for about 15 years. The land, zoned residential, is located in an affluent area and has good access to highways leading to both Minneapolis and St. Paul. The landowner at one time had development in mind, but recently offered to sell the land to the city as open space. Neither the city nor the county was interested in purchasing the land. Adding further pressure to develop this land was a city tax assessment in 1978 of $13,000. The inevitable result was that the land was sold in 22 lots, many of which were literally located in notches on slopes over 20 percent. The land development plan was reviewed by the watershed district, but all it could do was make the best of a bad situation because it had no land use authority to limit development. The watershed district did, however, insist on several on-site erosion control provisions, a measure well within the district's authority. Most erosion control measures were no more than minimally successful because of the steep slopes.

This example is a classic case of how external forces come to play in generating urban erosion. The watershed district could not limit the development; the soil and water conservation district similarly could not prevent the action; and the Metropolitan Council could not act on a local matter that did not require federal financial assistance.The fact is that a community wanting development will almost always be able to generate that development in spite of land resource limitations. In the previous example, the community had only to tax the land at a nonresidential tax rate in exchange for sanctions against development to prevent the "carving up" of a lovely, steep-sloped, fully wooded hill.

Communitites or citizens interested in affecting community policy should promote comprehensive planning as a method of protecting and preserving areas for land and water conservation purposes. An assessment of development alternatives made in light of resource limitations is the key element of a comprehensive land use plan. Integration of all comprehensive erosion/stormwater plans on a watershed basis identifies the overall ability of a community to develop and delineates its responsibilities to downstream communities. Once land is developed in an improper manner, corrective measures become extremely capital-intensive and damage to property is likely.

How to Approach Comprehensive Planning

Once a community has recognized the need for a comprehensive planning approach for its natural resources, it faces the job of preparing a plan that includes all aspects of community development. This paper addresses only part of the natural resource element of a complete comprehensive plan. The primary focus of any erosion/stormwater plan is definition of land capability and densities of development that that land can support. Herein also lies the key to good erosion control and stormwater management. It must be emphasized that even fully developed communities have to keep urban erosion control in mind because these communities will undergo redevelopment or undertake public works projects such as road and sewer line construction. The following itemized elements are the *minimum* that should be included by a community concerned with prevention of urban erosion.

Statement of Intent. Prior to any discussion of development a community should state its goal relative to development and the means to achieve this goal. A clear statement of the terms under which development proposals will be reviewed will result in time savings for the community and provide directions for those wishing to develop land in the community. Consistency in maintaining the community philosophy is extremely important from both a planning and a legal standpoint.

Identification of Resources. Protection of resources starts with their identification and the identification of the limitations they present. The resources that should be identified include erosive soils, steep slopes, wetlands, groundwater and surface water, unique woodlands and vegetation, and any other area feature that merits protection or would not support development. Limitations on development types and densities should be noted so that those looking for development sites will immediately know what land is available for use.

Areas to be preserved from development have to be identified and the means for protecting these areas (tax relief, purchase, etc.) formulated so that they continue to function as soil or water conservation areas. Developed communities should identify areas where planned redevelopment will occur.

Land Use. Once the land resources and limitations are defined, a community must identify the types and location of allowed uses in conformance with any inherent limitations. Land use plans should be accompanied by an outline of growth patterns in a staged or incremental manner to ultimate development.

Natural Resource Subelements. There are three natural resource areas that serve as the focal point for a comprehensive plan designed to mitigate urban erosion. First is an erosion and sedimentation control subelement which defines areas where development should not occcur, as well as explains the regulatory program that a community can implement for erosion control in other areas. This section will reference the development limitations and will begin to formulate an implementation program that will culminate in ordinances and standards for development. Subjects to be contained in this subelement are an assessment of the magnitude of the problem; identification of causes of erosion; identification of successful management techniques; feasible control options; and recommendations for implementation strategies.

Stormwater runoff management is the second natural resource subelement that should be addressed. This part will require technical expertise in the area of hydrology because of the drainage network design and storage alternatives to be formulated. The land use and protected area elements in preceding sections should interact intimately with the stormwater subelement if development patterns are to be determined by allowable runoff volumes and by areas where development is suitable. Possible subjects contained in this subelement are: definitions of drainage patterns; determination of runoff volumes, rates and paths; evaluation of drainage channels and swales; quantification of needed and available storage; identification of areas regulated by state or watershed agencies; and identification of runoff management techniques.

Water quality, the third subelement, will primarily address diffuse stormwater pollution. The first task should be to undertake a preliminary evaluation of the extent and magnitude of diffuse sources of stormwater pollution. Elementary concentration equations are readily available to combine with land use to determine approximate pollution loading. Next, an assessment of available treatment options, and the likelihood of their success in the community lays the groundwork for a water pollution abatement plan.

The natural resource subelements are being evaluated as implementation techniques under the Metropolitan Council's Section 208 water quality study. Nationwide emphasis is shifting from large-scale, capital-intensive structures to local source control for abatement of pollution and urban erosion. As point sources of pollution are brought under control, increasing emphasis will be placed in the control of diffuse sources associated with stormwater runoff. Communities should seriously consider including the three subelements outlined here as the prerequisite for comprehensive plans.

Regulations From Outside Agencies. A community today has to interface its activities with regulations of federal, state and regional institutions and with its neighboring communities. In the area of urban erosion control, a community reviewing a proposal will have to keep in mind all of the regulatory programs. A comprehensive plan should itemize regulations so that users of the plan are cognizant of regulatory programs.

Implementation. By far the most important element of any community's comprehensive plan is the section that outlines the means to be used to assure that the plan is successfully carried out. The best development plan is worthless if a community does not use it to guide its reviews and to form a framework for community growth. A good implementation scheme should contain ordinances and performance standards that developers would have to follow in any land-disturbing activity. Ordinance options vary from one all-inclusive ordinance to several separate ordinances covering erosion control, stormwater runoff, subdividing, road construction, zoning, wetland alteration, and so on. Performance standards should clearly describe the specific technical measures that must be followed to achieve a particular task. Performance standards will often include a financial bond that must be posted to assure that the standards are followed. An effective implementation program must have follow-up inspections to assure that the specifics of the ordinance and standards are being properly followed. Personnel should be assigned to inspect and maintain visibility among the various projects, even if they are assigned only on a part-time basis.

Communities have numerous implementation and assistance options available, as outlined in a prevous section. Zoning and ordinance authorities are of course the most direct way to deal with erosion/stormwater control. Additionally, an unincorporated community can insist on county project review, which usually includes further review by the soil and water conservation district; such district review is also a project approval option for incorporated municipalities. Any community within a watershed district can defer review of projects to the district, incorporate district comments into project reivew, or adopt regulations to supplement those of the district. State regulations controlling erosion/stormwater currently exist if alteration occurs to wetlands, floodplains, shorelands, or public water; if water quality is degraded beyond certain limits; or if sufficient environmental degradation is threatened to justify an environmental disclosure document. Unfortunately, many projects bypass state review, often for reasons less than legitimate. All institutions with regulatory or review authority also have the authority to prepare comprehensive erosive/stormwater control plans. A community should undertake such a plan as an integral part of its overall comprehensive plan and should also place pressure upon the other institutions to do similarly.

Financing. The greatest difficulty most communitites face is financing expenditures that accompany comprehensive plan implementation. Revenues will be needed to prepare engineering plans, acquire storage areas, design and install erosion control devices, cost-share management structures or a myriad of other undertakings. A capital improvement program (CIP) should be established to look at expenditures for projects and acquisitions for at least five years into the future. Under a well-structured CIP, projects and acquisitions can be outlined, assigned priority for funding, and implemented in accordance with the community plan. The CIP will also identify the source of the needed revenue and thereby give the community an idea of its capabilities to finance a community plan, thus compelling a community to look realistically at the future.

Summary

A community that tries to manage a single natural resource such as soil, without consideration of other natural resources and community growth plans, will likely have an ineffective program. The Metropolitan Council has seen that those communities that examine their resources and plan their long-term growth are the ones that develop logical and effective programs to control soil erosion. To be effective, communities should inventory their resources, quantify their problems, and integrate this knowledge into a plan and implementation program.

Agencies such as soil and water conservation districts or watershed districts can assist a community, but a community that wants to develop at any cost can undo all of the conservation activities of any agency. It is the community that must be dedicated to soil conservation and natural resource preservation if environmental damage is to be avoided. Future water quality management programs in Minnesota and throughout the country will be addressing urban erosion in a more thorough manner than has ever been undertaken. The community with a good approach to comprehensive erosion/stormwater planning will be best prepared to comply with future abatement programs.

Finally, and perhaps most importantly, the key to an effective soil erosion program is a vigorous implementation approach that includes follow-up inspections. Numerous examples exist of well-intentioned erosion management programs which failed because they did not follow the specifications.

Comprehensive community planning is a promising erosion control implementation technique. A community that looks to its future with concern cannot help but develop a logical natural resources approach that includes control of urban soil erosion.

THE USE OF SOILS INFORMATION IN THE PLANNING PROCESS: PROBLEMS AND PROSPECTS

Gunnar C. **Isberg**, President
Isberg, Riesenberg, Chelseth and Associates, Inc.
Minneapolis, Minnesota
Planning and Development Services

I. Introduction

The environmental movement, which gained considerable strength in the late 1960's and early 1970's has made us a society much more aware of the damage to our natural resources from past developments and the fact that our natural resources are finite. However, even though this movement has gained many proponents from different walks of life, much current development throughout the United States, whether it consists of residential, commercial or industrial developments, continues to take place with little or no consideration of the effect of the developments on the natural resources and vice versa. This in turn has lead to a number of prolems for the individual homeowner and landowner as well as the local communities where the development projects are located. Some of these problems include wet or flooded basements, backed-up sewers from inoperative private sewer systems, cracked or shifting foundations, soil erosion problems, especially in areas of steep slopes resulting in pollution of waterways, damage to buildings and highways, etc.. The practical results of these many and diverse problems is greatly increased costs to the homeowner or landowner in attempting to deal with these problems. In some cases, there may be no practical solution to the problems such as for rural housing developments with private sewer systems located in areas of high water table. In other cases, the cost of providing a solution is passed on to the local communities (and the taxpayers) as angry homeowners demand that the local communities bail them out.

Nor is this something that merely happened in the past; the fact of the matter is that it is a recurring problem in many areas of the United States. One of the major reasons for this is that the market place or land economics continues to exert a strong influence on where and how developments take place. While the "smart" land speculators and developers are starting to pay more attention to the limitations posed by some of the natural resources, including certain soils, to the developments on a particular site, others only become aware of the problem after purchasing a parcel of land and then attempt to pass off the problem to future landowners, including homeowners, in order not to sacrifice potential profits.

II. Ways In Which Soils Information Can Be Used In the Planning Process

In view of the continuing problems being faced by many homeowners and local government units from developments being located on poor soils, what can be done to avoid or minimize these problems? One obvious way is to incorporate soils and natural resource information in the total planning process. The following are some of the ways in which this can be accomplished.

A. As a Basis for Comprehensive Plans

In developing comprehensive plans, including land use plans, for a local community or region, much background information is gathered and analyzed to serve as a basis for the plan; including population, employment and growth trends. One of the very valuable sources of background information is soils and other natural resource information. The Soil Conservation Service (S.C.S.) has been involved in preparing soils maps and soils interpretation sheets on a county-wide basis in most portions of the United States since the early 1900's. These soils maps and soil interpretation sheets are prepared from soil surveys conducted by the S.C.S. personnel and on a federal-county cost-sharing basis. A District Conservationist is usually assigned to each Soil and Water Conservation District (usually coterminous with a county) to assist the local officials and landowners in using this information.

In terms of land use planning, soils interpretation maps can be developed from the original soils for agricultural production, limitations for buildings with basements, limitations for private sewer systems (septic tank and drainfields) etc.. These maps can then be used as one source of information in developing comprehensive plans and land use plans for a community or region. For example, areas which contain poor soils for development purposes (high water table, high shrink-swell characteristics, etc.), could be designated for parks and open space or storm water drainage areas, etc., or development can be severely limited in areas of high agricultural production. In this manner, this information can avoid or minimize the problems caused by urban developments on poor soils.

B. As a Basis for Development Ordinances

Another way that soils and natural resource information can be incorporated into the planning process is the use of this information as a basis for the ordinances used to implement the comprehensive plans such as zoning ordinances and subdivision regulations. For example, soils maps and soils interpretation sheets can be used as a basis for establishing zoning districts, especially in those communities that lack a comprehensive plan. In addition, the soils information can be used in establishing performance standards in the zoning ordinance or the subdivision regulations dealing with soil erosion and sediment control, wetland preservation, septic tank provisions, etc..

In addition to the zoning ordinance and subdivision regulations, soils information can also be used as a major basis for seperate ordinances in a local community including Soil Erosion and Sediment Control Ordinance, Wetland Preservation Ordinance, and Private Sewer System Ordinances. Several communities have developed seperate ordinances dealing with these subjects rather than to incorporate these standards in the zoning ordinances. Usually, the provisions are more lengthy and comprehensive when developed as seperate ordinances. Again, the use of soils information as a basis for development ordinances can help to avoid or minimize many of the development problems discussed previously, especially in communities that lack a comprehensive plan.

C. As a Basis For Subdivision Layout or Design

Another way in which soils information can be used in the planning process is in subdivision design and layout. In many cases, a particular parcel of property will contain areas which present severe limitations for urban development as well as areas which present little or no limitations.

Soils maps and soil interpretation sheets prepared by the S.C.S. (supplemented by additional soil borings) can be used to cluster the housing units or buildings in areas that present few limitations for urban development and locating the common open space parks and trails, etc., in areas which present limitations for development purposes. Similarly, the topography and vegetation on a site should be considered in subdivision layout. However, this may mean that the developer would be willing to accept fewer lots on the site (and potentially less profit), unless the community has imcorporated a density transfer system in its ordinances, which it may have to do to encourage the use of soils information in the subdivision design process.

D. As a Basis for Reviewing Subdivision Proposals or Redevelopment Proposals

Yet a fourth major way that soils information can be used in the planning process is to review subdivision proposals or redevelopment proposals by a governmental agency. One way in which this can be done is for the local staff to work with the district conservationist or other soil scientist in reviewing the development or redevelopment proposals and then negotiating with the developer to change the design or layout to minimize problems with buildings being located on poor soils. Another way of getting the technical soils information input in the review process is to appoint a district conservationist to the Planning Commission, which several counties in Minnesota have, in fact, done.

In summary, the soils maps and soils interpretation sheets, in some cases supplemented by additional soil borings where detailed soils analysis is needed, can serve as very valuable information in several stages of the planning process to avoid or minimize the problems with urban developments located in areas of poor soils.

III. Reasons That Soils Information Has Not Been Effectively Incorporated In The Planning and Development Process

In light of the potential usefulness of soils information in the planning and development process, it would appear that planners, engineers and other professionals involved in planning as well as local communities, would make a great deal of use of this information. Yet, to the utter frustration of soil scientists and district conservationists, soils information has by and large not been incorporated in the planning and development process in many areas of the United States. Even where soils maps and information has been included in planning reports, it has often been used as "filler" (fulfill some state or federal requirements to obtain a grant) rather than as a means to influence the final comprehensive plans or subdivision layouts. There are a number of reasons for this, some of which are valid and others which are not. The following are some of the reasons that planning professionals and local communities have been reluctant to incorporate this information in the planning and development process.

A. Lack of Knowledge by Planning and Development Professionals

One of the major reasons that soils information has not been more effectively used in many planning programs is simply due to a lack of knowledge on the parts of planning and development professionals that this information is available or how to use it in the planning process. Part of this problem is due to the fact that many curriculums for planners and engineers lack courses on soil properties and how this information can be used in the planning process. In addition, S.C.S. personnel or Soil and Water Conservation Districts have not always adopted effective local programs to "sell" the use of soils information in the planning process to planning professionals or local elected officials.

B. Lack of Interest of Professionals Involved in the Planning and Development Process

Another major reason that soils information has not been incorporated in the planning and development process is due to a lack of interest by many planning professionals or local officials in the potential use of this information. There are also several reasons for this attitude. In some cases, it is due to a lack of sensitiveness of the need to protect our natural resources. In other cases, the landowner or developer may be opposed to the use of this information in the planning and development process since it can adversely effect his or her profit margin. In other cases, the landowners and local communities may have adopted a strong pro-growth attitude and would be opposed to anything that might inhibit or limit development even if problems are likely to occur at a later time.

C. Limitations of Existing Soils Data

Another major reason that the use of soils information in the planning and development process has not been more widespread in many regions is due to the fact that the soils data is either outdated, in too generalized a form or is lacking entirely. For example, some of the soil surveys in Minnesota were conducted in the early 1900's using a soils classification system exclusively oriented towards agriculture or rural development issues. This type of information is obviously of very limited usefulness for urban planning programs oriented towards urban growth problems and issues. In addition, the older soils maps were often in a very generalized form, making them virtually useless for the type of planning activities requiring detailed data such as subdivision design and layout.

In some cases, the soils data may be lacking entirely such as for the older urbanized cities which were not included in the original surveys. The practical result of this is that soils information is not considered in evaluating redevelopment projects in the cities. In some cases, this has lead to some unfortunate results in that redevelopment projects, involving substantial public and private investments, have located in areas of poor soils or seasonally high water table with all its attendant problems. For example, this author is aware of at least one major federally sponsored housing project (Section 8 housing project sponsored by the Department of Housing and Urban Development) which was located in a former river-bed which had been filled to make room for urban development. The predictable results is that the walls started cracking from a shifting foundation and the housing project had to be abandoned after only 12 years because the walls were ready to cave in and the apartment units had to be torn down. Needless to say, this resulted in a substantial waste of public funds. Thus, steps need to be taken to prepare soil surveys of select areas of the larger cities which are subject to redevelopment projects.

IV. Criteria For Incorporating Soils Information in the Planning and Development Process

In view of the potential value of incorporating soils information in the planning process, it is important that proper steps be taken to further encourage this practice in the future. One of the ways of doing this is to improve the lines of communication between the soil scientist and the professionals and decision-makers involved in the planning and development process. In addition to improving the communication process, it is important that the soils information and data be produced in such a format as to be easily incorporated into the planning process. The following are some of the basic criteria for ensuring that the soils data can be used in the planning process.

A. Soils Information Must Be Up-to-Date and Readily Available

One of the basic criteria for ensuring that planners and other professionals involved in planning and development will consider the use of soils information in developing comprehensive plans and ordinances is that the information is up-to-date and readily available. As was indicated previously, one of the reasons that soils information has not been used in some areas is that the soils data is old and the soils classification system is of very limited value in properly addressing urban development problems. Thus, it is imperative that the proper steps be taken to update the old surveys as soon as possible. In order to deal with this problem in Minnesota, a 15 year plan was adopted in 1973 for completing a soil survey of the whole state which includes the updating of the old surveys. Under this accelerated soil survey program, the soil survey for the whole state is expected to be completed by 1989. The surveys will be done for each Soil and Water Conservation District which in most cases is coterminous with the counties. This program will ensure that the soils data for the whole state will be usable for both urban and rural planning programs and that this information will be uniformly available on a state-wide basis in the near future.

B. The Soils Data Must Be Capable Of Being Incorporated In The Planning Process

One of the major issues which has been extensively debated among planners and soil scientists is whether or not the current soils data is in such a format as to be useful to the planner in the planning and development process. There is no doubt that strong attempts have been made to produce the soils data in such a format as to be useful to planners, engineers and other involved in planning and development as well as to meet the requirements of rural and agricultural areas and that this has changed the soil classification system over time. However, there are some professionals who feel that soils data in its present format is of limited use in the planning and development process.

A soil survey for an area usually includes a series of maps upon which the soil types are superimposed. In addition, the survey report includes a description of the physical characteristics of the soils including grade and wetness, etc.. In addition, the soil survey reports include soil interpretation sheets which indicate the limitations and suitability of the particular soil type for various land uses, including urban land uses, open space, agricultural productivity, etc..

It is clear that the soils maps in the initial soil survey reports are of limited value in their existing format in the planning process. What is really needed to make the information useful in the planning process is to take the process one step further and to produce soils interpretation maps which indicate the suitability of the soils for agricultural production, the limitations of the soils for private sewer systems (wetness, permeability, steepness, etc.), or for dwelling units with basements (height of water table, etc.). It is in this format that the soils information can be used to determine land use plans or to influence subdivision design or layout. However, many planning professionals lack the knowledge of how to produce these soils interpretation maps. Even when the maps have been produced with the assistance of the soil scientist, there are issues related to the classification system used in these maps (severe, moderate, or no limitations).

In addition, many planning professionals feel that there is a need to develop more exacting standards in order for the soils information to really be useful in the planning process. For example, many planning professionals would like to see standards for minimum lot sizes for private sewer systems depending on soil types. On the other hand, the soil scientist will maintain that it is difficult, if possible at all, to develop simplistic standards from soils data.

It is clear from this brief analysis, that soils data can be useful in the planning process if the planner is willing to work with the data to produce additional interpretation maps and providing that the planner has a basic understanding of soils and soil properties. Unfortunately, many planners or engineers lack a basic understanding of soils and soil properties. It is also clear that oftentimes the planning professional is looking for simplistic standards which may not be available or may be difficult to produce. This suggests that there is a need for additional research involving soil scientists, planners, engineers, etc., to work on developing more exacting standards which can be used by professionals and decision-makers involved in the planning and development process.

C. The Soils Information Must Be Available At A Reasonable Cost.

As was indicated previously, soils information can and has been used in various different ways in the total planning process ranging from subdivision review to serving as a basis for a comprehensive plan. In addition, the information as used in the planning and development process range from rather simple hand-colored soils interpretation maps to very complex computer mapping systems.

The basic soil information reports produced for the individual Soil and Water Conservation Districts on a federal-local cost-sharing basis is usually available free of charge or on a loan basis to local communities. However, in order for this data to be used in the planning and development process, it often must be further analyzed and the basic information converted into a different format. For example, the soils maps as found in the soil reports produced for the Soil and Water Conservation District are in most cases not useful in their existing format. In most cases, new maps at different scales must be prepared and the basic soil groups converted to soil interpretation maps in order to make the information understood by lay planning commissions and local elected officials. This is especially a dilemma for planning and engineering consultants who firmly believe in the use of soils information as a basis for planning but are forced to compete with other consultants who are not using the soils information in their work. Many local communities, especially those where planning has a low priority, may not be willing to pay the extra costs necessary in converting the basic soils data and maps into a format where it can be used in the planning and development process. Thus, it is important that methods be developed to produce the information at a relatively low cost if it is to be used on a larger scale than isolated, individual communities as has been the pattern in the past.

E. The Soils Information and Standards Must Be Legally Defensible

Another element which must be considered in using soils information and standards in the planning process are the legal implications. In this respect, the standards must, to the extent possible, be legally defensible. This is likely to continue to be an increasingly important issue as developers and landowners in increasing numbers are turning to the courts to challenge ordinances and other governmental standards which place restrictions on the use of land and water.

There are at least two aspects dealing with the legal issues which may have an effect on the use of soils information in the planning process. One has to do with whether or not the standards are reasonable and therefore are likely to be upheld in the courts. Unless the planning and engineering professional has some assurance that the information or standards is valid and reasonable, he or she is unlikely to want to recommend that standards be used by local governmental units in the planning process. Another legal aspect deals with the willingness of the soil scientist to appear in the court as an expert witness if the soil standards or information is challenged. Obviously, the planner or other professional involved in planning and development would not qualify as an expert witness as it relates to soils. Thus, the soil scientist or district conservationist must be prepared to be used as an expert witness if the soil standards are challenged, which they are sure to be in the future.

V. Conclusion

It is clear that soils information can be extremely useful in both the planning and development process in order to minimize costly development problems for both homeowners as well as local governmental units. The soils information can be used in a variety of ways in the total planning and development process ranging from simple subdivision review to serving as a basis for rather complex comprehensive plans for a community or region.

In spite of the potential value in using soils information in the planning and development process, it is not being used to any great extent in many regions of the United States. The following are some recommendations for encouraging the use of soils information in the planning process.

For one, the communication channels must be opened between the soil scientists and district conservationists and the various professions and local officials involved in the planning and development process including planners, engineers, architects, local elected officials and developers. This improved communication could take many forms including written materials such as books and articles, and seminars and conferences. Since the decision-makers and local staff are constantly changing, this needs to become a continuous activity.

Second, there is a real need to develop additional and more exacting soils standards which can be incorporated in the planning process and also to produce the soils data in such a format as to be capable of being easily incorporated into the planning process. This will require a truly interdisciplinary approach of people with practical experience in such fields as soil science, planning, engineering, law, etc..

Finally, there may be a need to develop incentive programs at the federal or state levels to encourage the use of soils in the planning and development process. This could take the form of outright grants or specific requirements to obtain other grants in the area of housing, parks and open space, transportation, community development block grants and other major federal and state grant programs.

ROLE OF WATER RESEARCH INSTITUTES IN STORMWATER AND EROISON CONTROL

Neil S. Grigg
Assistant Secretary for Natural Resources, North Carolina
Department of Natural Resources and Community Development

James M. Stewart
Acting Director, Water Resources Research Institute
of The University of North Carolina

Each state has a Water Resources Research Institute which is partially supported by the Office of Water Research and Technology, U.S. Department of Interior. These institutes were initiated by the Water Resources Research Act of 1964 and have continued to evolve since that time. The North Carolina Institute is a particularly active one and has taken an especially strong role in stormwater and erosion control. The role of institutes in research, training, technology transfer and information dissemination can be very significant. The purpose of this paper is to describe the activities of the North Carolina Institute and to suggest that it could serve as a model for other state institutes with particular interest in the subject of stormwater and erosion control.

The basic missions of the water research institutes are water resources research, technology transfer and information dissemination. When considering the groups with strong roles in stormwater and erosion control it is easy to see that institutes are in a unique position to serve well in the special fields of training and information dissemination. The list of groups of concern in this conference illustrates this point: planners, consulting engineers, land developers, builders, conservation organizations and local government. The terms training, technology transfer and information dissemination are closely related and when taken together constitute a group of activities all of which might be called "technology transfer." The North Carolina Institute is well known for its strong program in technology transfer not only in stormwater but in other water and land related programs as well.

Stormwater and erosion control are fruitful areas for research and technology transfer. The North Carolina Institute considers that "stormwater management" is a field which consists of four basic activities: urban drainage, flood control in urban areas, control of erosion, and control of the quality of urban runoff. All of these areas are important and of concern to different groups at different times. For example, urban drainage is of great concern to local government particularly when drainage problems persist and generate citizen complaints. Flood control in

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urban areas is a major problem especially when disasters occur and lives are lost. Erosion control is very important from an environmental standpoint and because of the problem of siltation in streams and receiving waters. The nation's Water Quality Program has recognized the importance of the quality of urban runoff in achieving and maintaining clean streams.

The activities of the North Carolina Water Resources Research Institute in stormwater management have a long history. For example, the institute convened the first state workshop with the major agencies involved in land disturbing activities to address the sediment control problems and the need for regulatory action. This effort and early institute research was instrumental in gaining passage of the Sediment Pollution Control Act of the State of North Carolina. One of the features of that act is that the director of the institute serves as an ex-officio member of the Sediment Control Commission which directs the program. The institute director is thereby able to participate in rule making and decisions relating to the development and improvement of the State Sediment Control Program.

The Sediment Control Program has been evolving since its initiation and relies on a technical committee comprised of consulting engineers, professors, government people, land developers and other professionals with experience and interest in erosion control. The WRRI has participated actively in this technical committee by the participation of staff and principal investigators from research projects.

There have been a number of research projects supported by the institute of direct interest to workers in stormwater management. These include projects in the quality of urban runoff, projects in urban drainage, projects in the institutional arrangement for stormwater management, projects relating to the quality of agricultural and rural non-point runoff and cooperative projects with local government designed to find solutions to persistent and common stormwater management problems.

The institute has conducted several workshops related to stormwater management. In January 1978, a workshop was held to define problems which should be addressed by state government relating to stormwater. This resulted in a written set of proceedings.[1]

In April 1979, the North Carolina Institute, in cooperation with the water institutes and water agencies in the Southeast, sponsored the Southeast Conference on Urban Stormwater Management. The session explored the strengths and deficiencies of state and local programs related to urban stormwater management and identified and described necessary corrective steps in the areas of state and local legislation and regulations, administration, finance, and technology. Proceedings of this conference, available in December, includes specific recommendations for follow-up action programs in all these areas. The appendix gives the program for the workshop to demonstrate the diversity and quality of the presentations which were made. There have been other specialty workshops relating to stormwater management as well. In March 1979, the Institute sponsored for example, a one day workshop featuring a national expert on the subject of preparing urban runoff control plans. This workshop was well received and well attended.

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[1] Stewart, James M., "Proceedings - North Carolina Workshop on Management of Stormwater, Sedimentation and Flood Control in Urban Areas;" Water Resources Research Institute of The University of North Carolina, Raleigh, N.C., 1978.

In line with this technology transfer mission the institute has organized a working group of city engineers and others interested in stormwater management. This group is always invited to workshops and receives a regular newsletter concerned with stormwater management published on a periodic basis. The institute does not have the staff to service a working group on a regular basis but seeks to involve them as much as possible in regular on-going institute projects. The newsletter prepared for distribution to the working group and to others interested in stormwater management is called the "North Carolina Stormwater Manager." The most recent copy is appended as an appendix to this paper.

The institute cooperates with other units working in stormwater management as well. For example, the State of North Carolina is receiving one of the EPA projects which are designed to collect data to determine the magnitude of the non-point runoff problem in urban areas. A pilot project in the Winston-Salem, North Carolina, area will be initiated in the near future. The institute has been in close touch with the planners of the project and hopes to be in a position to help disseminate the findings as widely as possible.

In conclusion, Water Research Institutes can be of great benefit in each of the states to work with stormwater management constituencies. The program of the North Carolina Institute is full and complete and has generated considerable interest among local groups concerned with stormwater management. The North Carolina Institute will be glad to advise other institutes or similar groups on the development of its programs and on how others might adapt and learn from our experience.

THE NORTH CAROLINA

Stormwater Manager

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No. 4

GREENSBORO STREAMBANK STABILIZATION: RC&D PROJECT MOVES INTO SECOND PHASE

The City of Greensboro, with the help of the Resource Conservation and Development program (RC&D), is stabilizing some 5,140 linear feet of critically eroding streambanks in its parks with adapted vegetation and mechanical measures.

The two-phase stabilization program, begun in 1977, is being carried out by the "division-of-work" method, according to Jim Canterberry, State Resource Conservationist. That is, RC&D funds are providing the materials required, and the City of Greensboro is responsible for installation (providing supervision, labor and equipment). The Soil Conservation Service, using RC&D funds, is providing technical assistance through the Guilford Soil and Water Conservation District.

Phase One of the project included installation of 940 linear feet of riprap channel and 550 feet of channel bank shaping and vegetation on Hillsdale Park. Phase Two, scheduled for this fall, includes 800 feet of riprap channel and 600 linear feet of bank shaping and vegetation of Lake Daniel Park; 350 linear feet of riprap channel in Greentree Park, and 900 linear feet of riprap channel and 1,000 linear feet of bank shaping and seeding in Latham Park.

Estimated total cost for the project is $152,650, with $75,650 of that amount from RC&D funds. Greensboro is located in Guilford County, one of seven counties served by the North Central Piedmont RC&D Area. To receive this type of RC&D help, a city must be in one of the 35 counties that makeup North Carolina's six RC&D areas.

RC&D: HOW IT WORKS

By Frank Jeter

What is Resource Conservation and Development? And can it supply technical and/or financial assistance for stormwater management problems in North Carolina?

RC&D, as it is usually abbreviated, is a regional program supported by a number of federal, state and local interests to improve natural resource conservation, environmental quality, economic development and the quality of life. While the

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program has "grass roots" leadership from unpaid volunteers, the Soil Conservation Service of the U.S. Department of Agriculture is the lead agency in assisting RC&D areas, normally with one or more paid employees assigned to the RC&D area.

North Carolina has six active Resource Conservation and Development Areas that cover different sections of the state--but not every county in the state. The first test of eligibility to participate in RC&D programs is to be in one of the 35 North Carolina counties comprising an RC&D area. (Other applications have been filed, involving multi-county areas in several regions of North Carolina, but have not yet been approved by the Secretary of Agriculture.)

Let's say that you are in one of the six RC&D areas and you are seeking help with a problem in stormwater management. (Or any other natural resource problem.)

The first step is to identify the problem. This will probably involve a conference with the Soil Conservation Service District Conservationist. You may contact him by calling a local office of the Soil Conservation Service. After receiving suggestions from the District Conservationist, the next step will be the committee which is actually the governing board of the RC&D area. This group is generally known as the "Steering Committee," although other names are used.

If this group decides that the problem deserves attention, it may be designated as a "project measure" of the RC&D area. Project measures have a wide range, from recreation lakes to economic development, and may include flood protection, prevention of erosion, water quality, environmental aspects, even promotion of tourism.

A project measure, once adopted, may be eligibile for several types of assistance, including advice and guidance, technical assistance (including engineering assistance), financial aid, and even suggestions on alternatives available if direct RC&D economic support cannot be provided.

There are no "hard and fast" rules on what may be selected as a project measure. The RC&D steering committee is a major determining force in identifying the problem or need and in mustering the volunteer leaders of the RC&D area behind this need.

North Carolina's six RC&D areas and the counties they serve are: the Western Six--Cherokee, Graham, Swain, Clay, Macon and Jackson; the Mountain Valley --Madison, Buncombe, Henderson and Transylvania; the New River Valley--Alleghany, Ashe, Watuaga and a portion of Virginia; the North Central Piedmont--Rockingham, Caswell, Guilford, Alamance, Orange, Chatham and Randolph; the Mid-East--Hertford, Bertie, Martin, Beaufort and Pitt; and the Albemarle--Gates, Chowan, Perquimans, Pasquotank, Camden, Currituck, Dare, Tyrrell, Washington and Hyde.

Frank Jeter is Information Officer with the USDA Soil Conservation Service

REPORT PUBLISHED ON STREAM RESTORATION

A research report is now available on stream restoration as a means for restoring flow efficiency in streams that have become debris-choked and eroded due to the direct or indirect actions of humans. "Use of Fluvial Processes to Minimize Adverse Effects of Stream Channelization," WRRI Report No. 144, is by Nelson R. Nunnally, Department of Geography and Earth Sciences, UNC-Charlotte, and Edward Keller, Department of Environmental Studies, University of California, Santa Barbara. Copies are available from the Institute free for residents of North Carolina, and at $8 per copy out of state.

AGRICULTURAL BMP STUDIED

A research and demonstration project is underway in the Chowan River basin for implementing agricultural best management practices (BMP) for nutrient control.

In North Carolina an important component of nonpoint source inputs comes from runoff from agricultural land. Nutrients, for instance, like the nitrogen and phosphorous used on farms, can be transported to surface waters and in excess quantities can cause nuisance algal growths or "blooms" such as those that have plagued the Chowan River in recent years.

The research team headed by Dr. Frank Humenik of NCSU's Department of Biological and Agricultural Engineering will contrast nutrient yields before and after BMP's are implemented. Area farmers are being asked to cooperate and participate in the project, a measure which will help determine the effectiveness of the voluntary-educational-incentive approach for 208 implementation.

Other project objectives are to foster the necessary cooperative inter-agency expertise for 208 program implementation, both at the state and local levels, and to assess alternative 208 educational/informational approaches for reaching the desired clientele. The project will also evaluate the potential of survey methodology for adequately assessing producer practices and attitudes associated with 208 goals and implementation programs.

The thrust of management suggestions will be to emphasize simple, well-proven practices.

DURHAM DEVELOPS DESIGN AID

Recently the City of Durham adopted some design constraints for subdivision streets receiving strip pavement with no curb and gutter.

Engineers, concerned about erosion of street side ditches, selected 5.5 feet per second as the maximum permissible velocity in a street side ditch, based on criteria established by the Sedimentation and Erosion Control Commission.

Also of concern was the amount of flow in the ditches, so a requirement was adopted that the maximum flow in a street side ditch would be 25 CFS based on the 10-year design flow. But where ditch flow exceeded 25 CFS, the engineer would have to devise a way to reduce the flow, such as piping the ditch or directing flow away from the street.

Therefore, as an aid for design as well as review, the City developed a set of tables for the two different side slope configurations expected most commonly for street side ditches, the depth of which is controlled by the distance from the edge of the shoulder to the center of the ditch and which is fixed at 6' by NCDOT's typical section for subdivision streets. For each ditch configuration, the table gives the velocity of flow in the ditch as a function of the slope and amount of flow in the ditch.

For information on the tables, interested persons may contact Kenneth E. Wright, PE, City Engineer, Department of Transportation and Utilities, City of Durham, Durham, North Carolina 27701

APWA SERIES FEATURES URBAN DRAINAGE WORKSHOP

As part of its Workshop Series, the AWPA Education Foundation recently held a workshop on urban drainage.

Urban Drainage, offered as part of the Series' "Special Topics" category, was held in Salt Lake City, Utah, on July 26-27 and in Norfolk, Virginia, on July 31 thru August 1. The workshop was designed for public officials involved in the planning or design of urban drainage facilities or in code enforcements as well as consultants.

Among the topics covered were: new methods of stormwater management, stormwater runoff models, local drainage management practices, improved manual methods of drainage system design and alternative solutions for prevention of basement flooding and pollution from combined sewer overflows.

The APWA Series is made up of nine workshops on major public works operations plus a tenth reserved for special topics. Emphasis in each of the workshops is on administration and management.

COLUMBUS IN THIRD PHASE OF STORMWATER PROGRAM

The City of Columbus, Georgia, began its Storm Water Management Program back in 1975.

Now the five-phase endeavor, undertaken to lessen the damaging effects of poor drainage, soil erosion and sedimentation and flooding, is in its third phase and has been termed one of the most advanced and comprehensive programs in the nation.

Phase I of the Program, a Soils Inventory and Analysis, resulted in the publication of the Interim Soils Survey. The Survey is used by engineers, architects, developers and planners in appraising soils in Columbus.

Phase II was the collection of hydrologic data, the adoption of a sediment and erosion control ordinance and the publication of the Storm Water Management Handbook. The Handbook, a technical document to assist local agencies and engineers, provides guidance in such areas as estimation of stormwater runoff, design of culverts and storm sewers, flood proofing and allocating costs for drainage facilities.

Phase III, now underway, is the development of an Urban Flood Simulation Model. The Model will result in uniform procedures for all drainage design and will evaluate the consequences of flooding and the effects of preventive measures.

Phase IV has three parts. One, now in progress, is the Drainage Problem Categorization Study, which will result in a plan and map showing critical drainage problem areas and in recommendations as to categories and priorities for resolving Columbus' drainage problems.

Also part of Phase IV are the Study of Drainage Staff and Budget Requirements and a Pilot Basin Study, which will result in a drainage plan and cost estimate for the Pilot Basin. Pilot Basin Study results should demonstrate to citizens and the professional community the capabilities of the Program.

Phase V is the final and ongoing phase, the implementation of flooding and drainage measures and facilities.

The Program involves cooperation by a number of government agencies, city officials, developers, engineers and the public.

For more information on the Columbus Storm Water Management Program, contact:

Department of Community Development
Planning Division
P.O. Box 1340
Columbus, Georgia 31902

Telephone: (404) 324-7711, Ext. 546

APWA STARTS STORMWATER RESEARCH

A jointly funded stormwater project sponsored by the APWA Research Foundation was started July 15.

The 12 month, $75,000 project is a study of the planning, engineering and maintenance of urban stormwater control facilities. John A. Lambie, General Manager and Chief Engineer of the Ventura County (California) Sanitation District who is chairman of the Foundation's Board of Trustees, reports that there is widespread interest in the project, reflected by the number of participating agencies.

These include Tacoma, WA; Rockville, MD; Kansas City, MO; Charlotte, NC; Albuquerque, NM; Akron, OH; and the states of Virginia, Louisiana, and Illinois to mention a few. Herbert G. Poertner, formerly General Manager of the Research Foundation, is Principal Investigator for the project.

RESEARCH ON DRAINAGE

As land use changes from rural to urban, the cost of providing adequate drainage systems and reasonable levels of water quality rises. The greater proportion of land with high permeability in the rural setting results in lower runoff and higher water quality because the soil acts as a living filter improving water quality before it reaches the underground tile drains. In the rural areas, most tile drains flow into open drainage ditches that are very inexpensive to build because they have no concrete lining.

When urban development occurs, the least costly drainage system involves combining some of the open channel drainage systems with enclosed storm water pipes from the new subdivisions. This is still the least expensive system even when the open channels must be lined with concrete to maintain bank stability and to accommodate the increasing rate of flow in the channel due to the development of an urban rather than rural hydrograph. The water quality changes as urban development occurs because different types and concentrations of pollutants occur in the runoff from watersheds with large areas of low or zero permeability land surface. With the loss of soil as a living filter, further deterioration of water quality may occur.

The urban drainage system can be developed with or without detention storage capacity in the system. Complete pipeline systems with no open channels that have detention storage are more costly than pipeline systems without detention storage. The reduced cost of pipe because lower sizes are possible is exceeded by the additional cost of detention storage. This relationship holds whether the detention storage is one large facility or several smaller facilities distributed throughout the watershed. Detention storage is still more costly than pipelines alone even when the storage is a low grass area in a recreational park rather than a concrete lined facility.

Research indicates that the number of detention storage facilities is a positive function of cost in most cases. Therefore, a single facility is generally less costly than multiple detention facilities in the watershed. With very large volumes of detention storage, the number of facilities has strong interaction with the location of the facility so the economically least expensive system is a joint function of size, number, and location. (From "Systematic Development of Methodologies in Planning Urban Water Resources for Medium Size Communities", by W. L. Miller. Technical Report #111, November 1978, Water Resources Research Center, Purdue University.)

MUSKIE TO SPEAK AT DELAWARE CONFERENCE

Stormwater management programs should be readily understandable and accepted by the public at large. And a better understanding of management alternatives could help lower drainage problem costs (now an estimated annual $4 billion nationally).

With these ideas in mind, the University of Delaware Water Resources Center and OWRT offer Stormwater Management Alternatives: Turn a Liability, into an Asset, A National Conference. Senator Edmund S. Muskie will be the keynote speaker at the conference, October 3-5 in Wilmington, Delaware.

An objective is to formulate and review alternative methods for handling stormwater runoff that consider cultural, social and environmental factors as well as engineering design and cost effectiveness. The conference is for site planners, engineers, landscape architects, 208 planning agencies, state government planning agencies and commissions, river and port authorities, water and public works departments, conservation commissions, voluntary associations and individuals.

(continued)

Topics are: non-structural controls, structural controls, best management practices, design for multipurpose use, fundability and institutional arrangements and public information/participation and local support.

Registration deadline is September 26.

For more information, write: Conference Administration, University of Delaware, Water Resources Center, 42 E. Delaware Avenue, Newark, DE 19711.

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Acting Director: James M. Stewart
Editor: Barbara Partington

Water Resources Research Institute
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North Carolina State University
Raleigh, North Carolina 27650

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CONSIDERATIONS FOR THE DEVELOPMENT OF URBAN EROSION CONTROL ORDINANCES

Harlen K. Britt
Sedimentation Control Engineer
Division of Land Resources-North Carolina
Department of Natural Resources and Community Development

As we here today, fully realize, the problem of erosion and sediment control has received a great deal of national and state attention across the country. However, it is my belief that the problem can only be solved when local units of government take the initiative and begin the necessary steps to solve their particular problems.

Today, I would like to present to you several considerations for the development of urban erosion control programs based upon our experience in North Carolina.

North Carolina has had a statewide erosion control ordinance since 1973. This program has jurisdiction over all land disturbing activities except agricultural and forestry activities and those activities governed by the North Carolina Mining laws. The State's general statute provides for local units of government to adopt and administer their own erosion control ordinance. These local ordinances must meet minimum state requirements and may include more stringent standards, based upon local needs.

I would like to point out that in North Carolina we have experienced a great deal of pressure to require uniform ordinances across the State. I believe that from a contractor viewpoint that this is highly desirable but at the same time the geological and climatic differences and different environmental concerns of communities dictate that complete uniformity is not practicable. What we in North Carolina have developed is a performance oriented program that requires the same performance standards be met, however, we do not prescribe the method by which those standards are met. We believe by allowing flexibility in design that the technical minds involved will develop a better "mouse-trap". We also must admit some of our best ideas have come from the quote "non-technical" side of the construction industry, people like dozer operators and foremen.

We believe that it will take time to develop a workable program at any level and the construction industry's ideas that have been formed over the past 200 years are not going to be changed over night. In order to develop a successful program it goes without saying that you will need the support of the local construction industry and involved citizens.

A strong educational program as to the extent and seriousness of soil erosion must be carried out. This effort should be broad enough to reach the public at large and should include a diligent effort to reach those people who will be affected directly. The problems and possible alternate solutions must be discussed with developers, engineers, contractors, architects, realtors, conservation groups, local, state, and federal governmental agencies. The first discussion and decision to be made is whether a local unit of government really needs a soil erosion control ordinance. Is it really a need of that community and is the community willing to pay the cost necessary to carry out an enforceable effective program? If they are not, then I will be the first one to recommend that they drop the entire issue and not simply jump on the "band wagon". The very tough issue of whether the benefits are worth the cost must be settled and in most cases the decision will not be one easily reached. If however, the decision is made to proceed, then I can assure you that the more you involve the construction industry in the development of the program, the more success you are going to have. The soil erosion control program in your community is going to succeed only when the construction industry understands the need, the needed results, and can transmit an attitude of it shall be done down to the man on the dozer or motor grader. All the enforcement mechanisms utilized and all the great plans designed are not going to get the job done if the construction industry does not see to it that it is done. An improperly installed measure that fails in the first storm it faces may do irrepairable damage and all the enforcement in the world could not have made the construction workers understand.

Another area of education that we believe will help make your program a success is that of public awareness that an ordinance is in effect. In North Carolina, we developed a short 25 second public service announcement for television. This short spot informed people that sediment is our largest pollutant by volume and that plans were required prior to starting grading. It also stated where help was available if a project was starting or if a person was being damaged. In addition to this we recommend a continuing educational program directed towards civic and professional groups should be vigorously pursued.

I would also suggest that some method of phasing the program in be utilized so as not to be accused of coming down to hard to quickly.

Assuming that a program is developed, lets take a look at some technical standards. In North Carolina we have a performance oriented program with four technical standards. The first standard requires that a buffer zone be maintained between the land disturbing activity and any lake or natural watercourse so as to retain viable siltation within the first twenty-five percent of the buffer zone closest to the activity.

The second standard requires that all graded slopes must be provided with a ground cover sufficient to restrain accelerated erosion within 30 working days following completion of any phase of grading. This does not prescribe what method shall be used only that the accelerated erosion be restrained.

The third standard requires that all areas of one or more acres be so developed so as to prevent offsite damage from the silt generated by that activity during construction and that following completion of conthe twenty-five year storm.

Now that we have the technical standards the real strength of any local program will be the area of administration. How do you administer a local program with the least amount of cost? There are several ways to do this. First if an existing staff has the engineering capabilities tp review and approve plans, then the possibility exists to include this plan review in the present work load. If staffing is not available then hiring of additional staff may be warranted. There is another source which many of the local programs in North Carolina are using and that is the Soil and Water Conservation Districts. Many of our districts serve as the technical review board for local programs. The possibility also exists in contracting the work out to a qualified private firm for plan review.

Now that we have covered the possible way to handle the plan reviews, let's look at the actual inspection. Because erosion control on construction sites in a very dynamic process and because sedimentation damage may be a continuous problem, the frequency of inspection should be high. Staffing should be adequate to inspect a project a minimum of twice of week. Now, this may sound like a great deal of inspections but if damage occurs, it is not something that can be corrected very easily or inexpensively. I would recommend that all of the existing inspectors be crossed trained to recognize erosion control problems and when they visit a site for example a building inspection, they also perform an erosion control inspection. I am aware that there are many people who are in building, electrical, plumbing, and grading inspection work who feel they don't have the education or experience to handle another function, however, in today's government economic situation we need to cultivate the attitude that we will conserve and better utilize our existing personnel. An inspector who finds a problem could relay the information to the proper person who would then handle the situation promptly and effectively. I would also highly recommend a system of one stop permit shopping. This would allow all of the permits to be issued through one office and close cross checking of permits. It also reduces the number of offices and red tape that a developer must go through in getting the various permits needed for a project.

Let's assume that we have these plans being prepared and approved and the inspection procedure all worked out. Let me warn you that in my opinion you will not ever have a successful local program without a swift, manageable and just enforcement procedure. You are going to have violators, and in order to get continued good response and protection from the 95 percent good contractors, you must be willing and ready to deal with the 5 percent that will be continuous violators.

In North Carolina we have four types of enforcement action that can be pursued. They are civil penalty, criminal penalty, injunctive relief through the courts, and stop work orders issued by local governments. The civil penalty is assessed on a daily basis up to $100.00 per day, each day constituting a separate violation but may be assessed only after an official notice of violation has been served by certified or registered mail or personally delivered, This notice is required to include the specific laws that are being violated, the measures needed to comply, and a time period for compliance. This will give you the legal backing for proper notice and due process if assessment of penalties is necessary.

Criminal penalties are reserved for those persons who willfully and knowingly violate the ordinance. Injunctive relief and the stop work order are the most penalizing of all the enforcement procedures. Whenever you stop a project and tie up material and equipment, I can assure you that you will get attention. I suggest that injunctive relief and stop work orders be reserved for those cases where immediate damage is occurring and experience with the individual in the past indicates a strong possibility that voluntary action will not be achieved in a hort period of time. Injunctive relief is obtained through the courts and a stop work order can be set up administratively through your local staff. I do recommend that the power of issuing stop work orders be at the staff level but above the inspection level in order to provide for greater objectivity.

Any and all enforcement actions should allow for civil action to be taken through the courts for relief when a citizen is damaged by an erosion problem. I also would highly recommend that a provision be included in any local ordinances that would allow the person filing the claim to be reimbursed for legal fees as to be determined by the courts having jurisdiction. In most cases where damage has occurred and a person is entitled to compensation suits are not filed because of the fear that legal fees would drastically reduce any settlement to a point it is not worth the effort.

Another enforcement tool that can be very effective is to interrelate the permits for erosion control with other permits issued on a project. For example, if a building permit and occupancy permit are tied to an erosion control permit then if one permit is being violated the other permits can be withheld until everything is brought into compliance. Another provision that should be considered is one which would attach a lein against the property in cases where violations occur so that transfers of ownership would give the new buyer notice that a project is under enforcement proceedings.

Let's now look at possible ways of financing a program. The least expensive way of operating a program of course is to utilize existing staff and equipment, but in raising funds to operate a program you may wish to consider the following. One, a flat rate may be charged for each erosion control permit. Another way to finance would be to charge an acreage fee which may be variable depending upon size. For example, $200.00 for the first 2 acres and $50.00 for each additional acre. Many of our local programs operate this way. In several cases local programs are requiring the posting of performance bonds for a project set anywhere from $1,000 to $1,500 per acre which would be forfieted in cases where a violation is not corrected. Civil penalty collections can also be directed exclusively to your program and a great deal of effort has been expressed in developing a system of cost sharing with state and or federal government.

An interesting system has been developed in Wake County is one that charges an acreage fee of $135.00 per acre up to a maximum of 10 acres for a nine month permit. If stabilization is not completed in nine months another permit is required. The nine month permit period was derived by taking the past 3 years and obtaining the mean average length of time for projects and by dividing the number of projects by the weighted average size into the total operating budget. This type of permit encourages early stabilization of projects in the very beginning and penalizes those who let projects remain open for long periods of time and increasing the chance of offsite damage.

To summarize, first a community must evaluate the real cost and benefits of an erosion control program including any and all spin-offs. Make a long and very deliberate effort to bring all interested parties into the development process from the beginning. Once the program is developed an educational effort should be directed to all affected parties and to the general public. The ordinance itself should fit into other existing programs, be fairly and justly enforced with standards that allow for flexibility in achieving the desired results. It should utilize every available existing source of manpower and expertise and have enforcement mechanism which can be swiftly and fairly exercised by the staff.

It is our belief that the goal of any successful program should be one that will provide for the maximum amount of protection for our waterways and natural resources and still allow for the progress of a community to continue. This goal can be reached when reasonable people work together to achieve it.

URBAN PROVISIONS OF THE MINNESOTA COST-SHARE PROGRAM

Greg Larson, Program Specialist
Soil and Water Conservation Board
St. Paul, Minnesota

When the 1977 Minnesota Legislature provided the Soil and Water Conservation Board with three million dollars to develop and implement a comprehensive soil and water conservation cost-share program a long standing tradition was broken. Soil conservation incentive programs have historically been geared to agriculture and farmers. Urban, non-agricultural land, and property owned by non-agricultural producers have been generally not eligible for cost-share assistance.

This was particularly noticeable in Minnesota because since 1973, when the last Soil and Water Conservation District was organized, all of the state has been located within Soil and Water Conservation Districts. This includes a considerable amount of land heretofore ineligible for cost-share assistance. To clarify, it should be noted that U.S.D.A. Resource Conservation and Development (RC&D) projects, Public Law 566 Small Watershed Projects and a demonstration program funded by the Legislative Commission on Minnesota Resources (LCMR) have had roles, to some degree, in controlling soil erosion and sedimentation problems in non-agricultural areas.

Urban land is defined by the State Planning Agency as a 40 acre parcel containing 5 or more residential structures or at least one institutional or commercial development. Non-agricultural land is generally defined as wildlife land, roads, forest, pasture, open space and mined land. Estimates from 1975 place the Minnesota urban acreage at 1,260,000 acres or 2.3 percent, non-agricultural at 27,283,000 acres or 55.9 percent for a total of over 28,500,000 acres or approximately 58 percent of the state acreage. Located on this acreage are many severe erosion, sedimentation and related water quality problems. Although it emphasizes agricultural land, the Minnesota Soil and Water Conservation Board's Cost-Share Program addresses these problems wherever they occur within the state.

Within broad guidelines established by the State Board, Soil and Water Conservation Districts are responsible for locally administering every facet of the program. This includes accepting applications; issuing approvals and cancellations; assisting the Soil Conservation Service (SCS)

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in the technical aspects of the program; establishing local policies, cost-share rates and dollar limits; and issuing payment. Districts desiring to participate submit an application to the State Board. The State Board reviews the application and provides a grant to the District based upon technical resource data, State Board priorities and the historical ability of the District to administer such a program. Presently, the subjective aspects of the allocation are not significant as there is insufficient historical data on program administration.

Technical data is utilized from non-point "208" studies, Resource Conservation Act (RCA) appraisal data, advice of technical agencies such as SCS and. where applicable, the Conservation Needs Inventory (CNI). Because all urban and much of the non-agricultural areas were excluded from the CNI, the other data sources were used more extensively.

The cost-share legislation made it incumbent of the State Board and Districts to establish priorities and identify critical areas for treating soil erosion, sedimentation and related water quality problems. Moreover, it required that the priorities and critical areas be outlined in the program and long-range plans of the State Board and Districts, respectively. State Board and District priorities and critical areas do not necessarily have to coincide. To illustrate this, the State Board ranks groups of Districts on the basis of severity and the need for control measures. Presently, the smallest priority area is the size of seven Districts. However, an individual District's critical area map may depict areas of hundreds of acres. Likewise, priorities, because of planning scale, may also differ. In addition, time frame, local perspectives and the effects of land owner attitudes on District programs may cause differences in priorities between the State Board and Districts. Only if such a difference reflects a local program direction contrary to legislative mandates would a District's allocation be decreased or withheld.

This brief digression to discuss the planning process is important because, if for no other reason, planning provides a means for learning about the resource and the tremendous costs involved in treating it. From RCA appraisal data it is noted that urban treatment costs range from $50-$1,000 an acre with a $600 average being used for this program. On this basis, $33.8 million is needed in urban areas to reduce existing soil losses to tolerable levels.

Published figures are not available for non-agricultural land treatment costs but considering its vast acreage an estimate of $30 million is probably not unrealistic.

The jurisdiction of Soil and Water Conservation Districts over all the land in the state certainly ranks as one of the most significant features of the urban and non-agricultural provisions of this program. Others include construing land occupier as a broadly defined participant, the wording of the purpose and applicability of eligible control measures, and the emphasis on water quality.

Land occupier is defined in the program rules as "any person, firm or corporation, including the governments of this state and any subdivision, agency or instrumentality, corporate or otherwise, including, during the life of a practice, successors of a land occupier who received a cost-share payment. This definition also includes the federal government". Legalese notwithstanding, this definition includes conceivably anyone who lives in the state.

There are eight approved permanent, enduring, non-production oriented practices for controlling soil erosion, sedimentation and related water quality problems: erosion control structures, stripcropping, terraces, diversions, stormwater control systems, field windbreaks, animal waste control systems and critical area stabilization. All of the above except stormwater control systems have, in name, been well known to conservationists.

The stormwater control system practice is essentially a grass waterway but is broadly defined for non-agricultural use "as a system of components such as, but not limited to, waterways, diversions, sediment control structures, stabilization structures, culverts, channels and floodways to convey storm runoff to a constructed or natural outlet in a non-erosive manner". Furthermore, the applicability applies to "all lands" just as it does in the erosion control structures, diversions and critical area stabilization practices.

Technical responsibility of the program is assumed by SCS with District technical staff assisting them with every aspect. The State Board provides technical grants to Districts to augment the work force. It should be noted that the availability of technical assistance to meet the increased workload is a key factor limiting acceleration of soil and water conservation programs in both the urban and agricultural setting.

Because soil and water conservation programs have traditionally been geared to maintaining agricultural productivity, the inclusion of a water quality improvement goal is necessary to expand programs into non-agricultural areas. This, however, was not the State Board's only reason for including water quality. Nationwide non-point pollution efforts and the potential for increased federal funding were viewed as other causes.

The question of developers receiving cost-share assistance for erosion and sediment control is often asked. The Cost-Share Program Rules do not prohibit a District Board from cost-sharing with them, provided of course, that all other conditions are met. There are those who argue that developers should be compelled to control soil erosion and sediment via the regulatory approach. One cannot disagree with the apparent success of this concept in several states. However, it is safe to say that urbanizing pressures far greater than those of Minnesota caused the move to regulate. It may be some time before Minnesotans feel it necessary to take that action.

In the meantime, a portion of the Cost-Share Program funds could be used to establish demonstration projects for the purpose of depicting the effectiveness of control methods in developing areas. Although the costs of erosion control are generally an insignificant portion of a developers total site development costs, such an incentive may be instrumental in establishing demonstration practices in visible, complex and expensive to control areas. It also may be argued that such an educational approach may ease the transition to possible future regulatory programs.

Nine Districts have encumbered approximately $75,000 for non-agricultural and urban projects. Most of those approved have been municipalities and units of governments, others include corporations and private landowners. While $75,000 only represents about 3 percent of the total cost-share grants, it does represent a statewide distribution of projects and a new direction in soil and water conservation efforts. One must keep in mind that Minnesota is still overwhelmingly an agricultural state. Several references suggest that the urban acreage for the 7 county metro area ranges from about 10 percent in Scott County to about 70 percent in Ramsey County. Outstate figures are significantly below 10 percent with the majority at less than 5 percent.

Agricultural dominance and the existence of long standing soil conservation programs in rural areas make it difficult for urban and non-agricultural oriented Districts to adopt the same program implementation methods. The fact that cost-share programs are better known in the agricultural sector account for a large amount of walk in requests. While certainly not the best way to solicit priority clientele, it nevertheless provides local program support. Conversely, urban and non-agricultural Districts must sell their programs.

Earlier, references were made to the enduring nature of the approved practices and the type of urban or non-agricultural applicant presently being approved. The State Board requires in the cost-share rules that practices be maintained for a minimum of ten years or forfeiture of cost-shares may occur. Maintenance must be provided at the land occupiers expense unless failure or damage was due to circumstances beyond his control. In such cases, the repair or replacement may be cost-shared. The entire maintenance provision becomes clouded as urban land occupiers find it increasingly difficult to commit themselves to a ten year period knowing they may be under pressure within that time to abandon the project for development purposes. If abandonment occurs within the life span, the applicant may be compelled to return cost-shares. However, there are no legally binding provisions, short of deed restriction, to guarantee either maintenance or return of cost-shares if the land ownership changes. This may be one of the reasons why District Boards in areas of rapid development have chosen to give priority to municipalities and units of government.

Considerable administrative information about this program has been omitted. It was not intended to follow such items as a cost-share request through the step-by-step process, but rather to provide an overview of the background and philosphy of the Minnesota Soil and Water Conservation Board Cost-Share Program. The urban provisions as outlined are significant and may be the first of their kind in cost-share incentive programs. Such an effort may be viewed as an experiment, but hopefully it is one that proves to be successful. Present indications are promising.

COSTS FOR MANAGING A CONSTRUCTION SITE RUNOFF CONTROL PROGRAM

Margaret L. Zimmerman, Planner
CH2M Hill, Inc.
Boise, Idaho

This paper examines the management costs for implementing a construction site runoff pollution control program. The literature on construction site runoff controls has virtually no costs for the administrative or management functions. Generally, a cost of $1,000 to $1,200 per acre is given for implementing soil erosion and sediment controls. However, this figure primarily refers to the actual structural control or grading practice with no breakdown for the review or enforcement of the controls.

Because of this lack of cost data, a survey was made of programs currently operating in the country. The survey was made as part of a project for the Omaha-Council Bluffs Metropolitan Area Planning Agency, which was investigating the feasibility for an urban construction site runoff control program. This paper discusses (1) the problems associated with compiling comparable data, (2) the results of the survey, and (3) the unit costs derived from the survey results.

SURVEY DESCRIPTION AND LIMITATIONS

The survey consisted of informal phone interviews conducted by the author of this paper during November of 1978. The survey considered only those urban construction site runoff control programs that involved the submittal of sediment control plans by individual developers, review of the plans by the program management agency, and some sort of enforcement procedure, such as onsite inspections.

The primary objective of the survey was to identify the cost of the management program to the implementing agency. However, questions were also asked about the implementation procedures, number and type of employees, workload, and funding sources. A list of the questions usually covered during the conversation is given at the end of this paper.

As that list indicates, an attempt was made to break down the costs under administrative, enforcement, monitoring, and miscellaneous aspects of the management program. Administrative costs cover all clerical and other support services personnel as well as the reviewers of the submitted plans and the program management staff. The enforcement aspect includes personnel salaries and expenses for making inspections of the construction sites and for handling violators, such as making court appearances. Any expenses associated with measuring the effectiveness of the program in

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controlling pollution are taken to be monitoring costs. Examples of miscellaneous costs are overhead, training or education programs, and compliance incentives.

The intent of the questions was to get actual dollar amounts. However, more often than not, ranges or rough estimates had to be given based on individual salaries and approximations of the time devoted to the various program aspects. The inability to get any more definitive data was due to the nature of the programs. Most of the programs operating on a local level have been in effect for less than 5 years and are incorporated into other activities of the responsible agency, such as the issuance of building permits and the routine building inspections. As a result, the costs and other details pertaining exclusively to sediment control are often not known or documented. However, from the information and estimates provided by the officials, several unit values could be developed with varying degrees of reliability. The survey results and the derived unit values are briefly discussed in the next two sections of this paper.

SURVEY RESULTS

State, county, and city officials involved with sediment and erosion control programs were interviewed from the states of Georgia, Maryland, Michigan, North Carolina, Pennsylvania, Virginia, Iowa, Ohio, Illinois, and Indiana. Adequate data for interpretation were obtained from 18 programs representing all but the last four of the above states.

For these 18 programs, the total number of plan reviewers plus site inspectors associated with an individual program ranged from 1 to 13. All but two of the programs shared their clerical staff with other departments. Also, most of the reviewers and inspectors spent only part of their time on the runoff control program. The control plans submitted for review each year numbered from as little as 10 to as many as 1,200. Less than half of the 18 management agencies were able to estimate a total program budget. The annual budgets ranged from $10,000 to $264,000.

The following miscellaneous observations could also be derived from the interview data:

- Inspections per construction project ranged from 2 to 10.
- About 90 percent of the program violations could be handled out of court by working with the developer.
- Only three of the management agencies had the personnel and financial resources to offer an education or training program in construction site runoff controls.

Finally, some general information was gained regarding funding sources. Various combinations of the following funding sources were cited as potential financial alternatives:

- Federal and/or state grants or manpower assistance
- Plan review or inspection fees
- Violation fines
- Surety or performance bonds or escrow accounts to cover costs to correct violations
- General funds

Based on the phone survey, there appear to be two major funding arrangements used today. One arrangement used particularly by the smaller agencies is to just incorporate the program and management activities into the operations of an existing program, such as under the building inspection or public works departments. The second major arrangement is to use plan review or permit fees as a supplement to the general funds. Generally, the fees cover one-third to two-thirds of the total costs. The general rule of thumb is to not make a surplus, but to operate at or just under a level of self-sufficiency so as not to incur objections by developers and others required to implement the technical controls. The fees can be on a per plan or per acre basis with either a fixed or sliding scale.

The establishment of violation fines or the requirement of surety bonds functions solely as a safety valve for the management agency. These amounts are set at what it would cost the agency to correct any problems due to the negligence of the responsible party. They also function as an enforcement measure to avoid raising legal charges and incurring lengthy and expensive court proceedings.

Finally, several federal assistance programs may be used. Two avenues that are fairly frequently explored are the use of a CETA employee or the use of a SCS employee for plan review and/or inspection. There appears to be mixed feelings about involving the SCS. The larger and more sophisticated programs feel that going through SCS causes delays and inefficiency. On the other hand, some of the smaller operations welcome the help and even rely on the SCS employees to lighten the local agency's workload.

UNIT COSTS

The most reliable unit cost value that could be derived from the survey data was an estimated cost per acre for management of a sediment control program. Generally, the interviewed public official could estimate the number of plans submitted for review each year. Also, an acreage number of 5 acres per plan or construction project could be estimated. These values in conjunction with the estimated program budgets yielded a unit cost of $85 to $150 per acre.

This range in cost per acre can be used to estimate the cost for a proposed control program if the acres to be developed can be projected. For example, a theoretical County ABC may be interested in implementing a control program and projects that 250 acres will be developed each year for a particular planning period. The annual acres can simply be multiplied by several different costs per acre within the above range to obtain an estimated total management cost, as shown on Table 1.

TABLE 1

TOTAL ANNUAL AVERAGE COST FOR MANAGING A
CONSTRUCTION SITE RUNOFF CONTROL PROGRAM

	County ABC
Average Acres Developed Per Year	250
Total Annual Cost--	
At $85/acre	$21,250
At $120/acre	$30,000
At $150/acre	$37,500

Although not as reliable as the costs per acre value, figures for the time required for the different management activities and the cost per hour for each function could also be estimated from the survey data. An average of 1 to 2 hours per submitted plan appeared to be spent in plan reviewing, permit issuance, and miscellaneous administrative duties. The time spent in inspection and enforcement activities averaged 10 to 20 hours per construction project or submitted plan. The costs for office work versus field work were developed by one of the public agencies surveyed. That agency estimated that the office work came to about $25 per hour and the field work amounted to about $30 per hour, including all expenses, overhead items and other costs. These various unit values can be used to delineate management costs for a control program by area of responsibility, as shown on Table 2. Such a breakdown is especially significant when planning a program that may split the responsibilities among several agencies.

TABLE 2

TOTAL ANNUAL AVERAGE COST BY MANAGEMENT FUNCTION

	County ABC
Number of Plans Submitted Per Year(1)	50
Hours Per Year--	
On Plan Review and Misc. Admin.(2)	75 hr.
On Inspection and Enforcement(3)	1,000 hr.
Costs Per Year--	
On Plan Review and Misc. Admin.(4)	$ 1,875
On Inspection and Enforcement(5)	$30,000
TOTAL COST	$31,875

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(1) At an average of 5 acres per plan.
(2) At an average of 1.5 hours per plan.
(3) At an average of 20 hours per plan.
(4) At $25 per hour including all expenses.
(5) At $30 per hour including all expenses.

Table 2, in addition to presenting costs by management function, is also useful for two other purposes: (1) comparison with the costs calculated earlier on the basis of costs per acre and (2) estimation of required staff. A comparison of Tables 1 and 2 indicates that a reasonable estimate for management costs would be $30,000 to $35,000 for County ABC. The management staffing requirements for the projected number of control plans can also be estimated from Table 2. The workload and the resulting staff needs calculate to 1,075 hours and 0.52 man-years, respectively.

Thus, for County ABC, a staff of about one person working half time on the control program and an annual cost of $30,000 to $35,000 would be entailed to manage a sediment control program for the projected level of construction activity. Apparently the best arrangement in this case would be to share personnel with another program or department.

CONCLUDING OBSERVATIONS

The unit costs presented in this paper are admittedly based on a relatively small sample of programs and on some rather rough estimates. However, they have been presented here for three reasons. First, they may serve to emphasize the paucity of cost information in this area of pollution control but at the same time provide at least some guidelines for planning new programs. Second, nearly every individual interviewed indicated an interest in the survey results. It is hoped that the publication of this paper will respond to the interest of not only those public officials, but also to any others presently managing or investigating the feasibility of implementing a control program. Finally, the indicated interest may encourage agencies managing existing programs to document their workloads and costs by function or aspect as much as possible. The availability of detailed cost data from on-going programs is essential to develop cost-effective control strategies for nonpoint urban pollution sources.

SURVEY QUESTIONS

I. Administrative and/or Review Costs

- How is sediment or erosion control plan implemented?
- Who reviews and approves individual control plans?
- How many plans are submitted or reviewed in a given time period?
- How much does review and permitting process cost?
- What is cost of permit? How is cost determined?
- What other administrative costs besides plan review are involved?
- How are administrative costs financed?
- What is cost and financing source for technical assistance?

II. Enforcement Costs

- How is control plan enforced?
- Do you make regular periodic inspections of site?
- How long does it take to inspect site?
- Is an initial inspection made? How many inspections are made?
- Who makes the inspection? What are their qualifications or training?
- How are violators identified and handled?
- What are costs for inspection and handling violators?
- How are inspection costs financed?
- How are actions to handle violators financed?

III. Monitoring Costs

- Do you have a monitoring program?

- What is your monitoring program? Scale and frequency?
- What is cost of monitoring and how is it financed?

IV. General

- If program is voluntary, how effective has it been?
- Are there many violators?
- Do you have any incentives to encourage compliance with control plans?
- Do you conduct any education program to make it more effective?
- What is size of district or area?
- What is average acreage of new construction per year?
- What is size of management or administrative staff? What is staff makeup?
- What are your expenses or operating budgets per year?
- What overhead items are involved directly with the control plan?

MULTIJURISDICTIONAL STORMWATER MANAGEMENT: THE FOUR MILE RUN WATERSHED PROGRAM

Hugo A. Bonuccelli
Chief, Enviornmental Systems Engineering Section, NVPDC,
7309 Arlington Boulevard, Falls Church, VA 22042

John P. Hartigan, Jr.
Director, Regional Resources Division, NVPDC

David J. Biggers
Water Resources Engineer, NVPDC

Introduction

The basinwide streamflow impacts of urbanization in developing watersheds which enclose multiple jurisdictions are seldom evaluated. In general, each political subdivision within the multijurisdictional basin administers its own stormwater management programs, which are often restricted to the urban runoff which originates within the jurisdiction's boundaries, even though local drainage programs may negate or be jeopardized by stormwater management activities in neighboring political subdivisions.

Local jurisdictions typically possess neither the analytic tools to quantify such impacts nor the institutional mechanisms to address them. This paper presents a case study of a stormwater management program which has successfully addressed these difficulties by incorporating computer simulation techniques into a regional decision-making process based on the "joint exercise of powers" institution.

Background

As shown in Figure 1, the Four Mile Run Watershed encloses portions of two counties and two cities that are located in the Virginia suburbs of Washington, D.C. As a result of intensive suburban development which occurred within the 19.5 sq mi watershed following World War II, much of the basin's natural drainage system was replaced by an elaborate storm sewer network. Approximately 37% of the land surface within the watershed is currently blanketed with impervious cover.

Residential and commercial areas located near the mouth of Four Mile Run sustained property damages totalling more than $40 million as a result of seven floods between 1963 and 1975. The periodic flash floods in this area were attributed to the cumulative impacts of sewered urban development in the basin's four jurisdictions.

The Four Mile Run stormwater management problem was typical of the one encountered by many multijurisdictional watersheds today: each of the four political subdivisions administered its own land use planning and urban drainage programs with little regard for potential downstream peak streamflow impacts. Stormwater drainage systems were designed to transport storm flows downstream as quickly and efficiently as possible. Local public works and planning staff were equipped with neither the analytic tools nor the institutional mechanisms needed to

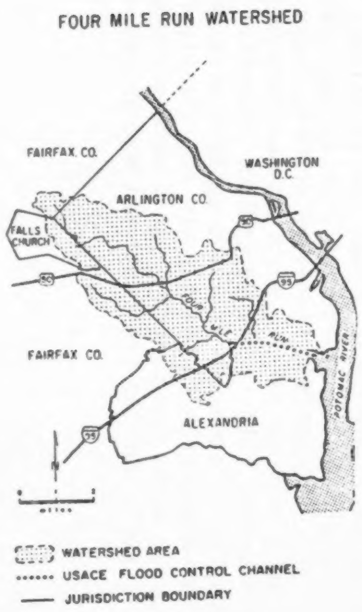
FOUR MILE RUN WATERSHED
FAIRFAX CO.
WASHINGTON D.C.
ARLINGTON CO.
FALLS CHURCH
FAIRFAX CO.
ALEXANDRIA
POTOMAC RIVER
FOUR MILE RUN
95
WATERSHED AREA
USACE FLOOD CONTROL CHANNEL
JURISDICTION BOUNDARY

FIGURE 1. GENERALIZED WATERSHED MAP

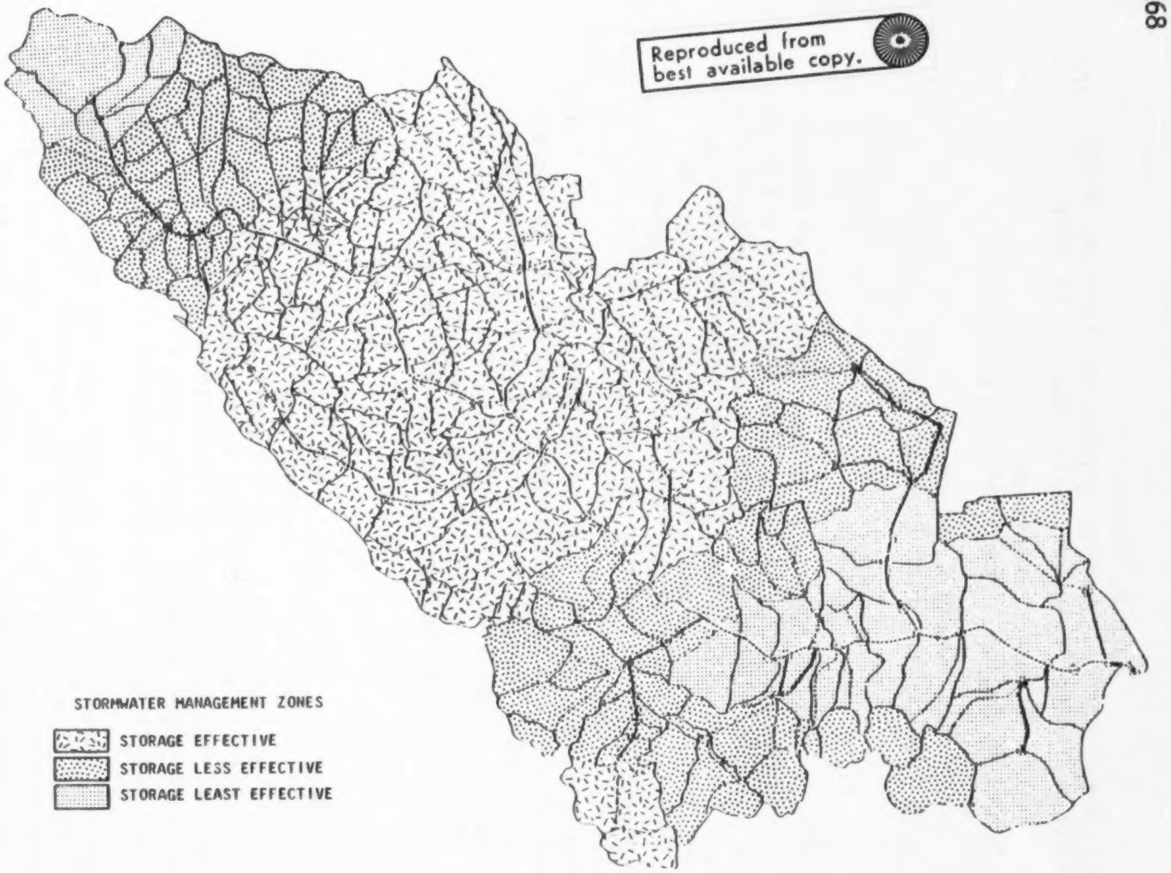
STORMWATER MANAGEMENT ZONES
STORAGE EFFECTIVE
STORAGE LESS EFFECTIVE
STORAGE LEAST EFFECTIVE

FIGURE 2. MAP OF STORMWATER MANAGEMENT ZONES

Reproduced from best available copy.

assess and reduce the downstream impacts which resulted from upstream land use changes.

In March 1974, Congress authorized a $50 million U.S. Army Corps of Engineers' (USACE) flood control project that is designed to provide protection from the 100-year streamflow event. The location of the flood control project is shown in Figure 1. In order to qualify for the USACE channelization and bridge replacement project, the Four Mile Run jurisdictions--Fairfax County, Arlington County and the cities of Alexandria and Falls Church--have been required by Congress to develop and implement a basinwide stormwater management program. This prerequisite is intended to assure that runoff from future urban development in the watershed does not produce streamflows which could impair the effectiveness of the federal flood control improvements. In the Four Mile Run project, Congress recognized an excellent opportunity to evaluate local structural and non-structural control measures that can prolong the life of federal structural controls. It is the first case in the history of USACE flood control projects in which a basinwide stormwater management stipulation has been attached to the commitment of federal funding.

In the spirit of intergovernmental cooperation, Fairfax County and Falls Church agreed in April, 1974 to participate in the development of a multijurisdictional stormwater management program so that Arlington County and Alexandria could qualify for the federal flood control project. The four jurisdictions requested that the Northern Virginia Planning District Commission (NVPDC), the regional planning agency for suburban Virginia, coordinate program development. A nine-menber Technical Advisory Committee (TAC) composed of planners and public works engineers from the four jurisdictions in the watershed was formed by NVPDC to guide program development.

A two-year study was required to produce a basinwide stormwater management program that satisfied the Congressional requirement. Initial stages of the NVPDC study focused on the technical, rather than institutional requirements of a multijurisdictional stormwater management program. Following the completion of the necessary technical analyses and the development of required impact assessment tools, an institutional mechanism for implementing the stormwater management program was identified.

Selection of Impact Assessment Tools

The proximity of the Four Mile Run Watershed to downtown Washington, D.C. makes its land area very susceptible to pressures for high density development. Such new development and redevelopment could not only reduce USACE project benefits considerably, but it could also destroy the Four Mile Run flood control structures. Consequently, preliminary stages of the NVPDC effort were devoted to identifying a planning tool for predicting and controlling increased flood peaks that could accompany new development in the watershed.

Two alternatives were considered by the TAC: (1) formulation of a regional land use plan for the ultimate development of the watershed and local flood control programs to contain the projected increase in streamflows; or (2) development of a computer-based mathematical model of watershed hydrology that could be used by the four jurisdictions to quantify and minimize the flooding impacts of their future land use decisions.

The ultimate development plan approach was rejected by the TAC because of serious political and technical shortcomings. The political problems stemmed from the jurisdictions' fear that a basinwide land use plan would destroy local autonomy. Technical objections to the alternative focused on its excessively long planning period, the high degree of uncertainty associated with utlimate development decisions, and its general inflexibility.

The mathematical modeling approach was found to be much more acceptable. The TAC selected the continuous simulation model STORM (8) and the single-event model WREM (9) as the watershed planning tools for the Four Mile Run program. Water Resources Engineers, Inc. of Springfield, Virginia was retained by NVPDC to calibrate and apply the models.

Development of Four Mile Run Watershed Models

STORM, a relatively simple tool utilizing a modified version of the rational formula to translate rainfall into runoff, was used to screen the watershed's 52-year rainfall record for critical rainstorms. The STORM analysis indicated that no historical rainfall event produced main stem flows with a recurrence interval in excess of 40 years. It was therefore necessary to synthesize a 100-year design rainfall event for use in the Watershed Management Program. The method of Keifer and Chu (3) was used to develop a watershed design storm. This is a very intense, 4-hour thunderstorm slightly skewed toward the receding limb, assumed to occur instantaneously over the basin. This storm was used in conjunction with model WREM to define the design streamflow event for the Management Program.

Since the Four Mile Run versions of WREM have been described elsewhere (2,4,5), only a brief summary is provided here. WREM is a second-generation version of the USEPA Stormwater Management Model. The model consists of three major programs which are executed sequentially: (a) Land Use Management (LUM) Program, which converts land use into impervious ground cover; (b) RUNOFF, which converts rainfall into surface runoff and utilizes kinematic wave routing to develop overland flow and flow in minor conduits; and (c) TRANSPORT, which routes flows through major conduits by means of a numerical method solution to the equations of motion and continuity.

An advantage of model WREM is its sophisticated hydraulic routing capabilities, which enable it to represent open and closed conduits of varying cross-section as well as elements such as orifices and weirs. A number of runoff control measures can be simulated, including wet and dry ponds, parking lot and rooftop ponding, seepage pits, and porous pavement.

Following calibration, model WREM was designated as the principal impact assessment tool for the Four Mile Run Watershed stormwater management program. Proposed land use changes and drainage improvement projects can be assessed with the model and the design storm to determine whether or not the associated runoff changes impair the effectiveness of the USACE flood control channel. The April 30, 1975 land use pattern was chosen as the initial "baseline" for the assessment of future development impacts.

Development of an Institutional Framework

After the impact assessment tools had been calibrated and procedures for model application had been developed, alternative stormwater management institutions that could be established with existing State enabling legislation were evaluated by the TAC. Emphasis was placed on institutions that not only were suited to multijurisdictional watersheds but also promised to provide an effective framework for the application of the basinwide impact assessment tool. The following institutions were considered by the TAC: (a) drainage district; (b) water and sewer authority; (c) sanitary authority; (d) soil and water conservation district; (e) watershed improvement district; (f) special service district; and (g) joint exercise of powers.

The first three of these were judged by the TAC to be too limited in scope for the multijurisdictional runoff management program. The powers associated with the soil and water conservation district and the watershed improvement district were found to be very appropriate for the Four Mile Run runoff management program; however, these institutions were considered to be politically infeasible because they would require the delegation of land use planning related powers to an independently elected board of directors. While a special service district could have fulfilled the technical requirements of the management program, it was also deemed politically infeasible, since Virginia law prohibits the creation of such an entity in one portion of a regional planning district unless such action is preceded by the dissolution of the planning district commission.

Although it had not been previously utilized for water resources planning and management programs in the State of Virginia, the joint exercise of powers institution (Section 15.1-21 of the *Code of Virginia*) was selected by the TAC for the Four Mile Run program because it was found to be both technically and politically acceptable. This institution permits two or more jurisdictions to jointly exercise any power, privilege, or authority which they are capable of exercising individually. The TAC viewed the joint exercise of powers institution as an extremely flexible tool for implementing the basinwide stormwater management program. Unlike many of the other institutions that were evaluated, joint exercise of powers permits the four jurisdictions in the basin to preserve local autonomy while jointly exercising specified powers. This was viewed as particularly appropriate since local elected officials were somewhat apprehensive about new regional programs. The ability to use staff from the existing regional planning agency (NVPDC) further enhanced the institution's attractiveness.

Features of Joint Exercise of Powers Program

On March 31, 1977, the four jurisdictions in the watershed executed a joint exercise of powers Memorandum of Agreement that established the Four Mile Run Watershed Stormwater Management Program. As defined in the Memorandum of Agreement, participation in the program requires: (a) the provision of local runoff controls for all future "drainage modification projects" (i.e., projects that involve a change in the watershed land use or drainage system), hereinafter referred to as DMP's, to minimize downstream flooding impacts; (b) financial participation in a basinwide impact assessment program that relies upon the model WREM; (c) periodic review of all drainage modification projects with the impact assessment tool WREM to project cumulative impacts of local land use changes and drainage improvements; and (d) implementation of structural and/or nonstructural corrective measures to nullify any USACE channel flooding projected by the impact assessment tool WREM. To assure that the impact assessments assume a multijurisdictional perspective, the Memorandum of Agreement has established a watershed policy board and technical committee to administer the program. Technical and administrative support for the program is provided by NVPDC. The annual operating budget for the Watershed Management Program activities is approximately $50,000.

The policy board, known as the Runoff Management Board, is composed of the chief administrative officers from the watershed's four jurisdictions and the Executive Director of NVPDC. Each chief administrative officer has one vote. NVPDC serves as secretariat for the Runoff Management Board and its Executive Director serves as non-voting chairman.

The Board oversees the operations of the Watershed Management Program. It meets at least once a year to review the annual report of the technical committee and to adopt an operating budget for the ensuing fiscal year. The Board may be convened at any other time at the request of any Board member to resolve runoff management policy issues resulting from the technical committee's deliberations.

The technical committee, known as the Technical Review Committee, is composed of one local public works engineer from each of the watershed's jurisdictions and a representative of the NVPDC staff. Each local member has one vote. NVPDC serves as secretariat for the Committee and its representative acts as non-voting chairman.

The Technical Review Committee is responsible for conducting the technical investigations required to determine the downstream impacts of proposed drainage modification projects. It meets at least once per quarter to review documentation on local projects proposed for the watershed. Individual and cumulative impacts are projected with the model WREM and the design storm.

A jurisdiction sponsoring a DMP proposal shown to generate runoff increases that cause excessive streamflows within the flood control channel is required to implement corrective measures in accordance with a schedule that must be reviewed by the Technical Review Committee. If the Committee fails to reach an agreement on the impact of any proposal or series of proposals, or if any jurisdiction wishes to contest a Committee decision, a special session of the Runoff Management Board is convened to resolve the dispute.

The Committee is also responsible for the preparation of a Quarterly Report which includes documentation on the individual and aggregate impacts of all DMP's and corrective measures that have been reviewed during the previous quarter, and on the schedule for provision of any outstanding corrective measures. The reports are forwarded to the Runoff Management Board, local boards of supervisors and city councils, the USACE Baltimore District Engineer and other pertinent agencies.

Impact Assessment Procedures

Once per quarter, the local jurisdictions submit standardized forms to NVPDC summarizing all drainage modification projects (DMP's) approved during the previous quarter. Local site plan review processes have been altered to insure that appropriate data on DMP's can be generated for use in the Program. If a jurisdiction suspects that a particular project may cause negative impacts, it can request a separate assessment, funded by the developer, prior to local site plan approval.

Upon receipt of the summaries, NVPDC assigns each DMP to one of two categories for impact assessment. Projects which are less than two acres in size are assigned to a Parameter Adjustment File. These small projects are allowed to accumulate within one of the idealized model subcatchments until a sufficient number are present to warrant adjustment of the parameters describing the subcatchment in the model. Larger projects are assessed through the use of detailed representations known as SITE models, which are formulated as follows: (1) The subcatchment(s) enclosing the DMP are extracted from the watershed model. (2) A detailed SITE model of the DMP and the residual subcatchment is developed to permit an in-depth analysis of local conditions. (3) The extracted subcatchment(s) is replaced in the watershed model by hydrograph(s) generated by the detailed SITE model, and the watershed model is executed with the design storm to define projected impacts in the flood control channel. (4) If negative impacts are noted, the SITE model is used to evaluate effectiveness of onsite control measures, and downstream impacts are checked by repeating step 3 with modified SITE model hydrographs.

Program Accomplishments

During the first 30 months of the Watershed Management Program, 223 local DMP's were reviewed. In all, 144 local DMP's have been incorporated into the watershed model. Six SITE models have been developed. The DMP's incorporated into the watershed model represent the addition of 54.7 acres of impervious cover and 37 runoff control measures providing a total of 5.6 acre-feet of detention storage.

In addition to the required quarterly review activities of the Program, a number of other impact assessments have been undertaken. At the request of the Management Program's member jurisdictions, preliminary model assessment studies have been conducted with funding from private developers to determine the probable effectiveness of control measures at nine DMP's. In four cases, the downstream benefits of detention storage were documented. In four other cases, control measures were deemed unnecessary. As a result of the remaining study, two of the jurisdictions are currently designing a detention pond which will straddle a mutual boundary. A tenth study documented the benefits of downsizing a planned culvert, resulting in significant cost reductions for a member jurisdiction.

In addition to these studies, a pair of major SITE model studies for outside agencies have been completed. The first, funded by the Virginia Department of Highways and Transportation, involved the assessment of a 4.5 mile segment of Interstate Highway 66 which traverses the northern section of the watershed. The I-66 project involves the addition of approximately 100 acres of impervious surfaces and stream channel improvements to the watershed. Initial watershed model assessments indicated that the original I-66 stormwater management scheme, which included one detention pond with approximately 9 acre-ft of storage capacity and which focused primarily on control of runoff impacts in the vicinity of the highway, would result in adverse downstream impacts. Following a series of watershed model evaluations of alternative runoff control levels, it was determined that a major diversion structure and two detention ponds with a total storage capacity of approximately 38 acre-ft were required to adequately address projected downstream impacts. If the Four Mile Run Stormwater Management Program were not in existence, these supplemental controls would not have been considered since the original highway drainage scheme addressed the localized, rather than the basinwide impacts of I-66.

The second study, funded by the U.S. Department of the Navy, involved the assessment of a major stormwater detention facility at the Henderson Hall U.S. Marine Corps station in the eastern portion of the basin. The facility, which is to be constructed with excess excavation material from redevelopment construction at the site, will provide approximately 17 acre-feet of detention storage, in addition to resulting in a net savings to the Federal government of approximately $280,000, due to reduced offsite disposal costs. Model WREM assessments indicated that sizeable downstream peak streamflow-reductions would be obtained if the project were approved. The documentation of the basinwide impacts and benefits associated with this DMP would not have been possible had the Management Program not been in operation.

Both of these studies were further noteworthy in that neither the Highway Department nor the U.S. Navy were signatories of the Memorandum of Agreement under which the Program is implemented, and thus not legally bound to accept the results of the model assessments.

Another special study was undertaken because applications of the watershed model during the course of Management Program operations had revealed wide variations in peak flow impacts resulting from drainage modifications at various points in the basin. This watershed sensitivity study was intended to investigate such locational differences in streamflow response. A hypothetical 20-acre DMP and a typical control measure were simulated at twenty locations throughout the watershed and the resulting flows in the flood control channel compared.

The results of this analysis indicated that, for the Management Program design storm, the middle and upper middle portions of the watershed are most sensitive to the addition of impervious cover. The effectiveness of stormwater detention measures was likewise projected to be greatest for these locations. Additions of impervious cover to areas in the headwaters of the basin and near its mouth were projected to result in little or no adverse peak flow impacts in the flood control channel, while the provision of detention storage at these locations tended to be ineffective or counter-productive.

As a result of this analysis, the watershed was divided into stormwater management zones based on the probable effectiveness of detention storage. These zones are shown in Figure 2. Although larger projects will still require detailed analysis, these zones can be utilized by local staffs during the plan review process to determine whether detention storage should be required at smaller sites.

The results of the model assessments to date indicate that, as a result of the activities undertaken by the Watershed Management program thus far, the 22,500-27,000 cfs capacity of the flood control channel is not exceeded in any idealized reach, and that projected peak streamflows in the flood control channel have actually decreased since the Program was begun.

Advantages and Disadvantages of Watershed Management Program

The use of a hydrologic simulation model as an ongoing planning tool in the Four Mile Run Watershed Management Program has yielded many significant benefits. One of the most important of these is that the four jurisdictions are now able to view the entire basin as an integrated system. It is no longer necessary to pursue a "piecemeal" approach to drainage improvements in the watershed. By addressing the complex hydraulic interactions which result from changes in the magnitude or timing of flows at any point in the watershed, it has enabled the local jurisdictions to identify and address the basinwide impacts of development projects, resulting in less controversy than previously encountered, and fostering greater interjurisdictional cooperation. Further, by demonstrating the inappropriateness of uniform detention ordinances in the basin, it has prevented the expenditure of funds on needless or harmful control measures, ensuring a more optimum expenditure of stormwater management resources.

The major disadvantages of the use of simulation modeling for such a program center around model complexity and data management. Since local public works staff had generally not recieved the specialized training necessary to utilize a model such as WREM, extra precautions had to be taken to insure that the modeling process was adequately understood and to prevent inappropriate interpretation of modeling results. Since large volumes of data are necessary to develop, apply, and routinely update such a model, extra care had to be taken to insure the completeness, accuracy, and manageability of the data base. However, neither of these problems have resulted in serious obstacles to program implementation.

Utilization of the "joint exercise of powers" institution as the framework for the Management Program has also yielded significant benefits. One of the major advantages of this institution is its flexibility. Whereas other institutions such as authorities and special districts may require the delegation of specific powers to an independent governing board, the joint exercise of powers institution allows the participating local governments to tailor the powers of the new program and the composition of the management board to suit their mutual needs. Thus the participating jurisdictions can design a program which has clearly defined responsibilities and powers for regional management, but which does not threaten local autonomy in the public works and land use planning decision-making processes. This allows maximum utilization of existing staff and maximum local control of program development.

The major disadvantage of program implementation under the joint exercise of powers institution is a lack of independent regulatory authority. However, the Four Mile Run Watershed Management Program has demonstrated that such independent authority is not needed if voluntary cooperation based on mutual acceptance of a common impact assessment technique can be obtained.

Summary

A regional stormwater management program implemented under the joint exercise of powers institution and utilizing a hydrologic simulation model has been described. This program fulfills a federal requirement for a basinwide land use management program while preserving local authonomy. It assures that the cumulative effects of development in four political jurisdictions are identified and addressed before downstream impacts become economically irreversible.

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URBAN EROSION & SEDIMENT CONTROL: METROPOLITAN TORONTO

Ajit Sahabandu, P.Eng.
Project Engineer-Development
Water Resource Division
Metropolitan Toronto and Region
Conservation Authority

I INTRODUCTION

The purpose of this article is to outline the existing erosion control program together with the proposed sediment control program for the river valleys of Metropolitan Toronto, in the Province of Ontario, Canada. In doing so the primary focus will be on:

(a) a brief discussion of man made problems, which have resulted in an acceleration of the natural erosion process; and

(b) the existing or proposed protective and preventative components of the program.

II BACKGROUND

(A) General

The river valleys are undoubtedly one of the most beautiful parts of Metropolitan Toronto; but with a rapidly expanding populace there exists a heavy demand for development of the valley system. The significance of this general process is magnified by the increasing pressures for the use of land within and abutting erosion susceptible areas. Two of the basic reasons for this appear to be:

(a) that Metro Toronto's boundaries are defined and hence creates pressure for in-filling of the valleys, they being one of the few areas remaining undeveloped; and

(b) that the aesthetics and value of the valley system makes it prime land for development.

Land abutting a valley is much sought after and, therefore, it is inevitable that awareness of the problems of erosion would increase because of the potential economic loss to owners and the concerned public. Consequently, it is also somewhat inevitable

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that many attempt to increase the area of usable land by attempting to develop close to the valley side slopes or by introducing fill or poorly designed structures on the slope.

The rapid rate of urbanization within Metro Toronto brought about a proportionate increase in the magnitude and frequency of problems caused by erosion. The physical problems were compounded by the administrative problems arising from the many agencies involved in the municipal process; some having no jurisdiction and others with overlapping jurisdictions to control such situations. There was clearly no central agency responsible for the administration of these problems. In addition, prior to 1974 the Province of Ontario did not have a comprehensive policy or program to deal with river erosion or slope instability within the valleys.

With the obvious need for overall co-ordination, in September 1974, the Provincial Government of Ontario designated the Metropolitan Toronto and Region Conservation Authority as the central agency which should have the responsibility and jurisdiction to control, monitor, plan and implement an erosion control program. The program is funded on a 55%:45% basis between the Province of Ontario and the Municipality of Metropolitan Toronto.

The Conservation Authority (hereafter referred to as 'The Authority'), as its first task, decided to study WHAT the extent of the existing problem was, WHERE the problems were, and WHY the problems existed. This basically involved establishing an inventory of sites and documenting the type and extent of the problems. The resulting study generated the required data base to plan for the erosion control program. It was evident at this stage that the Authority should develop a two pronged management program which contained a protective component to look after the existing problems and a preventative component to minimize future problems.

At present the Authority does not have an approved sediment control program underway; but is now in the process of preparing a twin plan similar to the existing erosion control program.

(B) Causes of Erosion and Sources of Sediment

The acceleration of erosion is introduced through man's activities and consequently is essentially subject to man's control. The following activities are particularly significant causes of erosion and hence also identifies the sources of sediment within Metro Toronto:

- cutting of trees and shrubs during preparation for urban development
- careless lot preparation and grading
- creation of impervious surfaces during urbanization: resulting in an increase in runoff and higher river velocities
- increasing the instability of valley walls by allowing structural development (buildings and retaining structures) to encroach upon steep slopes
- encroaching upon the natural flood plain with earth fill
- careless design of urban river structures with associated effects on the river bank and/or valley wall
- changing natural drainage patterns by means of storm sewers and channels
- widespread use of sand and salt in the winter months.

(C) Effects of Erosion

Due to the continuing population growth and increasing urbanization of Metro Toronto, it is inevitable that the public has become more aware and concerned of the damages associated with erosion. These damages include:

- danger to human habitations and loss of private property adjacent to the valleys
- loss of structures within the valley systems
- loss of valuable open space in parklands and ravines
- loss of mature vegetation and fertile soil
- sedimentation.

(D) Effects of Sedimentation

Damages and effects of erosion and of the sediment generated from these sources fall into three broad categories:

- loss of capacity in channels, sewers and water impoundments such as flood control reservoirs

- interference with navigable waterways (e.g. the Keating Channel) and the Toronto Harbour

- the effect on the quality of water for the following desired uses: water supply, public health aspects, recreation, fish and wildlife, and aesthetic values.

III MAN MADE PROBLEMS

It is evident that it was an initial lack of foresight and inappropriate technical planning of and for the river valley system that resulted in the necessity for establishing a remedial work programme.

For the purpose of this article, I will confine myself to a brief discussion of some examples of the man made problems now requiring remedial action in Metro Toronto:

(A) Inadequate Setbacks

(a) Location of Residential, Industrial and Commercial Facilities: Insufficient concern over adequate setbacks for dwellings and other permanent structures prior to issuing of building permits. Also, more concern should be shown in the location of ancillary structures including garages, parking lots, pools, fences, etc.

(b) Location of Recreational Facilities: It is evident that there should be more serious planning regarding the location of bridge (river) crossings, bicycle pathways, walkways, tennis courts, baseball diamonds, etc. being introduced in the valley system. The ideal acceptable use of a valley would obviously be to leave it in its natural state. In an urban community such as Metro Toronto, it is prudent to utilize open space for other acceptable uses including recreation. However, improperly planned recreational facilities within the valley system are also subject to erosion processes.

(B) Fill Problems

Landscaping and final grading plans for valley walls and table land abutting a valley when submitted for authorization are usually reviewed only in a surficial manner. There is relatively little emphasis placed on the stability requirements such as: the type of fill, internal drainage characteristics, the total volume of fill introduced or the method of placement where the degree of compaction is too often overlooked.

Indiscriminate filling of backyards and valley walls introduce surcharge loads, destroys vegetation and may affect internal drainage by sealing off seepage zones. Excessive loading of a bank or the table land immediately adjacent to the bank with either a structure (such as an above ground pool) or soil material, together with any associated disruption of internal drainage can give rise to not only surficial bank failures but also deep seated rotational failures.

(C) Storm Water Management

Inadequate storm water management, both on a macro level, in the development of subdivisions, industrial and commercial complexes; and on a micro level (i.e. individual lots) have contributed towards the problem of river erosion in Metro Toronto.

From a macro surface drainage standpoint, the creation of essentially impervious surfaces during urbanization with the introduction of streets, sidewalks, driveways and parking lots provide for a direct increase in volumes of runoff, which in turn result in high velocities and, therefore, increased rates of erosion in the river. The indirect effects resulting from a reduction in infiltration and its associated effects on ground water characteristics and vegetation are just as important.

From a micro standpoint, poor control of water discharging from downspouts, pipe outlets, swimming pool drainage and poor lot grading contribute towards the overall problem by way of surface erosion (sheet, rill and gully) and the build up of hydrostatic pressure within the soils.

(D) Destruction of Vegetation

The loss of vegetation contributes to an increased rate of surface erosion. Re-colonization of disturbed areas is often slow and the pioneer species do not usually provide the same stabilizing influence as the previously well established species. There also appears to be little attention given to the selection of plant material most suitable for certain slopes vis-a-vis soil type, pH, moisture content, shade tolerance, etc.

(E) Inadequate Planning and Design of Structures

Careless design and location of retaining walls placed without regard for drainage requirements pose slope instability concerns. Improper location of manholes, sewer outfalls and sewer crossings; together with poorly aligned bridge piers and abutments, deflect or back eddy the flow of water and hence contribute to the erosive process.

The foregoing man made problems indicate that there appears to be an obvious lack of public awareness regarding the use of the valley resource system. Therefore, it is imperative to make developers, home owners, the municipalities and the general public more cognizant of these factors.

Municipalities, being hemmed in by political boundaries, are often concerned only about their local problems. Consequently, it is important to look beyond the local problem to ascertain upstream and downstream effects of a particular proposal. This is best achieved by an agency such as the Conservation Authority; which, having jurisdiction over the entire watercourse, is in a position to weigh the overall effects prior to recommending appropriate design criteria.

IV OBJECTIVES

Having established the problem and its implications, the Authority's goal is to minimize the hazards of erosion to life and property, and at the same time to help improve the quality of the rivers and Lake Ontario through selective controls on sediment sources. This is accomplished by instituting a protective and preventative program which is directed towards achieving the following objectives:

(a) Implement a program of major and minor remedial works for the control of erosion in the 'Primary Watercourses' of Metro Toronto.

(b) Implement a program of sediment reduction through on-stream erosion control works and off-stream planting programs.

(c) Recognize the importance of retaining the natural valley character in the design of remedial work.

(d) Establish regulatory controls over development occurring in areas susceptible to erosion in order to eliminate the need for future remedial work.

(e) Provide advice to municipalities and landowners in order to achieve reasonable control of sediment generation; particularly on construction sites.

(f) Co-operate with municipalities and landowners in the planning and design of urban drainage systems which should include storm water management and sediment reduction concerns.

(g) Update and augment the current state of the art regarding erosion and sediment control in the Authority's jurisdiction.

V PROTECTIVE AND PREVENTATIVE PROGRAM

The erosion and sediment control program is to be composed of three major components:

(A) Erosion Protection

(B) Sediment Reduction

(C) Prevention

(A) Erosion Protection

The erosion protection program recognizes that rivers in an urban area cannot always follow their natural course of evolution, but will have to be contained in certain areas.

The protective component is for existing problems and includes major and minor remedial work components. Major work sites are those where a permanent structure or a sizeable parcel of land will be threatened in the near future and hence costly engineering work is required for its protection. Minor work sites are those where a small amount of protective work carried out now will prevent a serious problem from developing later: a "stitch in time saves nine" approach. Major remedial work at specific sites is carried out on a technical priority basis and is complemented by regular monitoring and analysis of site conditions in order to update the data base. Due to the dynamic nature of erosion, the site priority list is reviewed and revised annually, in preparation for the following years work program.

In evaluating and assigning priorities three major categories are considered: Effect on structures, Valley Wall factors and River action. The category entitled Effect on Structures is deemed the most important and accordingly weighted heavier than the physical and geological factors associated with the other two categories. Effect on structures include parameters such as the state of erosion, distance to structures and the number, size and type of structure(s) affected. The valley wall category includes the height of valley wall, slope angle, vegetative cover, groundwater conditions and the soil type and composition as parameters; whereas the River action category considers the river alignment and the cutting action for parameters.

The Authority's protective program is essentially geared towards the protection of private property (structures and land) and the protection of defined public open space. Erosion control work is carried out in accordance with the following operational criteria:

(a) Watercourses or parts thereof draining an area equal to or greater than 1300 hectares are classed as primary watercourses. Corrective works within primary watercourses are the responsibility of the Authority. Watercourses or parts thereof draining an area less than 1300 hectares are classed as secondary watercourses. Corrective works within secondary watercourses are the responsibility of the municipalities.

(b) Except where defined otherwise, top of valley wall to top of valley wall is described as the area in which the Authority will undertake remedial works for erosion and slope instability problems.

(c) In assessing the severity of a problem, a priority or ranking is given to each site. The priorities serve as the basis for the development of the annual works program. The priorities are developed on technical criteria, including geotechnical and physical parameters; and are formally reviewed on an annual basis.

(d) For the purposes of remedial works, design blocks are established and work is undertaken by design block. Design blocks are of a size that are technically and economically feasible.

(e) Where remedial work is proposed on private land, the Authority requires a permanent easement or title to the land and/or a suitable financial contribution from the benefitting owner.

(f) Remedial works are analyzed on the basis of cost/benefit, with property acquisition cost being used as a principal determining factor.

(g) Design criteria for remedial works are dependent upon the nature of each specific problem. Generally two types of problems exist: The first, and less common type, involves a bank or valley wall instability, in which slumping or major rotational failure are involved due to inherent soil conditions or overloading of the bank. The more common type of problem involves the river in coincidence with a valley wall. Where possible, erosion control work is designed to certain specified technical criteria:

e.g.
- accommodate the 100 yr. flood for the 'Coincident Case'
- accommodate at least the 10 yr. flood for the non coincident case. The level to be raised in accordance with the development of the watershed.

(h) In order to minimize the impact of remedial works on the valley ecosystem, an "Environmental Inventory" is undertaken prior to the initiation of any works. The analysis and resulting recommendations are considered as input to the planning, design and implementation of the proposed work.

(B) Sediment Reduction

In recognizing the sources and extent of sediment that might be generated, together with its adhesive contaminants, it is necessary to initiate a control program which will be directed at reducing the associated quantitative and qualitative concerns. The Authority proposes to accomplish this task by concentrating its efforts on keeping the sediment at or as near to the source as possible. The sediment reduction program will include a protection component, which will provide "On Stream" and "Off-Stream" controls; and a prevention component, which will help control the development of future problems.

The program will address itself to the major sources of sediment in the Metro Toronto area, viz: urban construction activities, river bank erosion and landslides. Of these sources, the predominant source appears to be sediment generated from construction activities. Hence the most effective control program would be one that is directed towards the source. The suggestion is to control this prime source through regulatory measures, and therefore will be discussed within the sub-section entitled "Prevention Component".

The problem of sediment generated from river bank erosion is to be minimized by providing "On Stream" protective works, such as flow control structures and bank armouring which will help reduce the erosive potential.

"On-Stream" and "Off-Stream" sediment control in the river valleys are to be carried out in accordance with the following operational criteria:

(a) On stream sediment reduction work shall be undertaken on all watercourses within the jurisdiction of the Authority.

(b) In assessing the severity of a problem, a priority or ranking shall be given to each site. The priorities shall then serve as the basis for the development of annual work programs. The priorities are to be based on technical criteria.

(c) In the design of sediment reduction works, the Authority shall be cognizant of any natural surroundings and shall endeavour to provide ancillary benefits, such as the improvement of fish habitat, where appropriate.

(d) Vegetation establishment will be carried out on Authority and municipal valley lands, including those lands leased to other public agencies for management and open space purposes, in accordance with a priority system established on the basis of site conditions, location of land in the watershed and the ancillary benefits of vegetation establishment. The latter includes improvement of wildlife habitat and perhaps, more importantly, enhancement of the human environment.

(C) Prevention

In order to be fully effective, an erosion control and sediment reduction program must endeavour to prevent future problems in addition to rectifying existing ones. The protective program is strictly a reaction to an immediate need, but does little to control the causes. Therefore, there is an obvious need for long term planning over large areas with consideration of the whole watershed system.

The preventative component involves planning to prevent or curtail future problems by establishing regulations and policies, coupled with planning tools such as development approval prerequisites. The history of erosion and sedimentation in the Metro Toronto area points clearly to the need for implementing strict development control measures. Where applicable, zoning and land use controls must recognize the existence of hazards and provide adequate "set backs" for new development or redevelopment.

The success of any preventative program requires the co-operation and working endorsement of the Authority, its member municipalities and other appropriate government agencies. These will assist in reducing future problems, which in turn will reduce public expenditures and improve the quality of Metro Toronto's rivers and Lake Ontario.

Erosion and sediment related problems are minimized through the institution of the following operational criteria:

(a) Buildings or structures (including paved surfaces), whether situated above or below ground level, will not be permitted in the following erosion impact zones unless studies by a competent professional show that the structures will be safe during their life, which for Authority purpose is 100 yrs:

- The 100 year dynamic slope line plus 10 metres; if no toe or slope protection;
- The stable slope line plus 10 metres; if toe protection only;
- 10 metres from top of slope; if both the toe and slope are protected or are considered to be stable.

(b) Surface drainage from any building, structure or paved surface shall not be permitted to be discharged over the valley wall. Such surface drainage must be directed away from the face of the valley wall or appropriately piped to the base of the valley wall.

(c) The municipalities shall be requested, in reviewing and approving development proposals, to ensure that any appropriate restrictions or conditions be applied as related to the Authority's erosion impact zone and generally, for any proposed development adjacent to watercourses and valleys that may aggravate or create future erosion or slope instability problems.

(d) The municipalities be requested to have master drainage plans prepared for developing areas which will then be complied with as the individual subdivisions are developed.

(e) In conjunction with the municipalities and other appropriate agencies, the Authority shall endeavour to have storm water management methods incorporated into new development.

(f) The municipalities shall be requested, in reviewing and approving development proposals, to ensure that any appropriate restrictions or conditions be applied as related to on site sediment control.

(g) The Authority shall endeavour to increase public awareness of the problems of erosion control and sediment reduction by disseminating information and providing technical advise, where necessary.

VI CONCLUSIONS

(a) Erosion, being a dynamic problem, provides a continuous change of site conditions. Therefore it is important to correct a problem at the early stages, where the age old adage of a stitch in time ...... or an ounce of prevention ...... hold true.

(b) An appropriate level of funding is imperative in order to stay ahead of the existing problems, which can only increase at a greater rate with a rapidly expanding urban community.

(c) It is important to plan for prevention or control of future problems by adopting consistent policies with requisite legislation or by-laws at all levels of government.

(d) Ensure adequate administration and enforcement of regulations and by-laws.

(e) The public at large should be made more aware of the valley resource system and the proper use of this invaluable commodity.

EROSION AND RUNOFF CONTROL IN NORTHWESTERN COLORADO

Thomas L. **Elmore**
Water Quality Management Coordinator
Gerald E. **Dahl**
Regional Counsel
Northwest Colorado Council of Governments
Frisco, Colorado

Background

The Northwest Colorado Council of Governments (NWCCOG) includes six counties in the mountainous area of Colorado west of Denver. The area is predominantly rural, but developing rapidly. It contains the ski areas of Aspen, Vail and Steamboat, among others. Significant portions of the region are underlain by major low sulfur coal deposits, which are being strip mined in increasing amounts.

The combined effect of tourism and the energy industry have created strong development pressures in the region. Land ownership patterns are such that developable private land is often located in the valleys, close to the streams of the region. Two-thirds of the area, typically the mountainous portions, are managed by the Forest Service and the Bureau of Land Management. The combined effect of strong growth pressures and the limited private land available is causing heavy development very close to pristine water bodies. The effects of poor construction practices are strongly felt.

A strong sense of responsibility exists among the residents of the region toward protecting their natural resources. The natural scenic beauty and scarce water resources are highly valued. Long-time ranchers have an interest in maintaining the productive capacity of their land. Those who support the tourist industry recognize the value of maintaining attractive natural conditions. Old and new residents agree that development can occur, but that it must be done so as not to damage existing environmental quality.

Stringent environmental controls have come to be expected by local residents. Virtually all wastewater treatment plants use advanced waste treatment to protect high quality trout fisheries. The construction of Interstate 70 over Vail Pass is widely recognized as the state-of-the-art in high altitude revegetation and erosion control. Many residential developers voluntarily establish landscaping and revegetation within the short construction and growing season.

Problems also exist. Urban areas are developing close to pristine streams, and urban runoff is becoming a major problem. Roads and developments completed only a few years ago without adequate revegetation are a continuing source of sediment. The scarcity of land is forcing development into stream environment zones, eliminating wetlands, and creating flood hazards. A system was needed for establishing uniform minimum standards for these development activities.

The Problem

In 1975, NWCCOG received planning agency designation under Section 208 of the Clean Water Act. The challenge for this program was to develop a system of controls which would protect existing high water quality, establish uniform controls, minimize new regulatory obstacles for developers, and minimize new staff requirements for small local governments.

The Solution

The key to the regulatory program developed by NWCCOG is tying together existing regulatory programs to effectively deal with the problem. These programs include subdivision and land use codes, floodplain regulations, Clean Water Act point source permits (National Pollutant Discharge Elimination System (NPDES) permits), and Clean Water Act dredge and fill (404) permits.

The first of these programs, county subdivision and planned unit development codes, requires three steps for county approval. These are sketch plan, preliminary plan or plat, and final plat. At the sketch plan stage, the developer is alerted to several requirements which may affect his decision on the layout of the project. These are:

- Requirements for stream setback and floodplain,
- Possible need for a 404 dredge and fill permit,
- Requirements for erosion control and revetetation plans (site dependent),
- Requirements for site coverage and impervious cover, and
- Possible need for an NPDES stormwater discharge permit.

By alerting the developer to these potential requirements early in the process, project siting can often be arranged to eliminate onerous requirements, or to make compliance less complicated (Figure 1). For instance, by establishing an appropriate stream setback, the need for a 404 permit or floodproofing can be eliminated. By minimizing impervious cover and providing adequate infiltration facilities, NPDES permits can be avoided. By siting the development on gradual slopes and stable soils, erosion controls can be simplified.

If the developer is unable to avoid a regulatory requirement, the local system is designed to cause minimum delays. For instance, when the sketch plan is submitted, evidence of application for a needed 404 or NPDES permit is required. It is not until final plat approval that evidence of the issued permit is required. This arrangement allows both the local plat approval and the regulatory process to run concurrently. Delays for the developer are thereby minimized.

Figure 1
Project Site Selection, Preliminary Design

STREAM SETBACK		
- 250' - 150' - AVOID 100-YR FLOODPLAIN	OR	- 404 PERMIT
EROSION CONTROL		
- LESS THAN 30% SLOPE - STABLE SOIL - LESS THAN 5 ACRES	OR	- EROSION CONTROL PLAN - REVEGETATION PLAN - PERFORMANCE BOND
STORMWATER CONTROL		
- IMPERVIOUS COVER LIMITS - DETENTION/INFILTRATION FACILITIES - NO RUNOFF INCREASE OVER BACKGROUND	OR	- NPDES PERMIT

Best Management Practices

The regulatory approach being used in our region takes advantage of the developer's experience in dealing with varied sites. The local regulations set performance standards, but do not require specific control techniques.

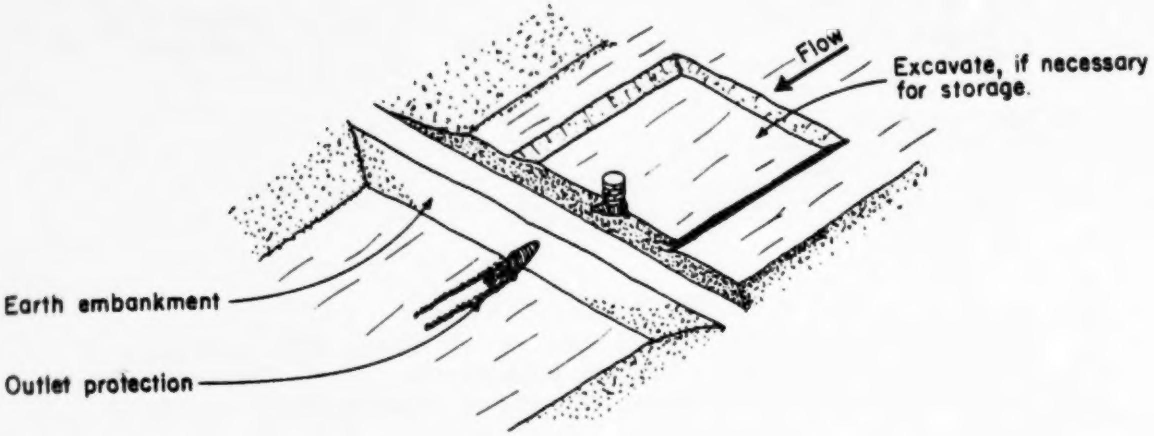
Some guidance on control techniques is provided. A "best management practices" handbook is provided to the developer in each county. It provides simplified calculation techniques for determining runoff from the design storm, the amount of detention or infiltration capacity that is needed, and specifications for control practices (Figures 2 and 3). This handbook, together with informal review by county staff, minimizes the amount of specialized professional help that the developer will need to comply with the regulations.

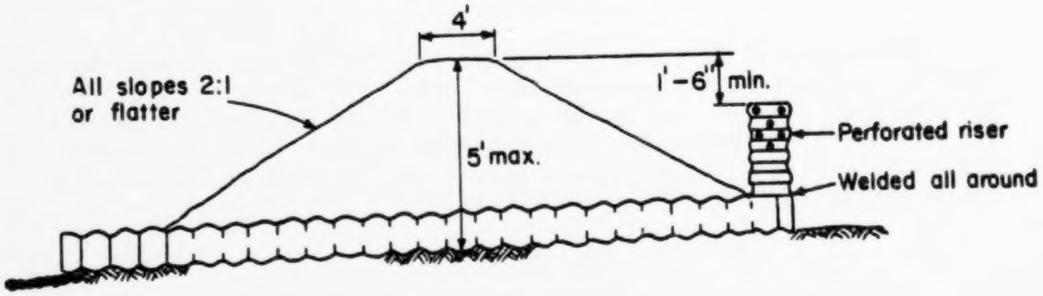
This approach provides flexibility to the process, since the handbook can be more easily amended than local regulations. It allows the developer to be involved in the process, and to develop and recommend better control techniques. This dialogue between local government and the construction industry should result in the handbook continually representing state-of-the-art controls.

Implementation

Assisting in plan implementation is now the task which faces NWCCOG. The water quality plan sets forth policies and administrative guidelines (Figure 4). In order to avoid having this plan set on the shelf among many other similar plans, NWCCOG staff are assisting directly with implementation. Example regulations are drafted by legal staff for each county. Similarly, best management practices are developed by the NWCCOG engineering staff which are specific to each county.

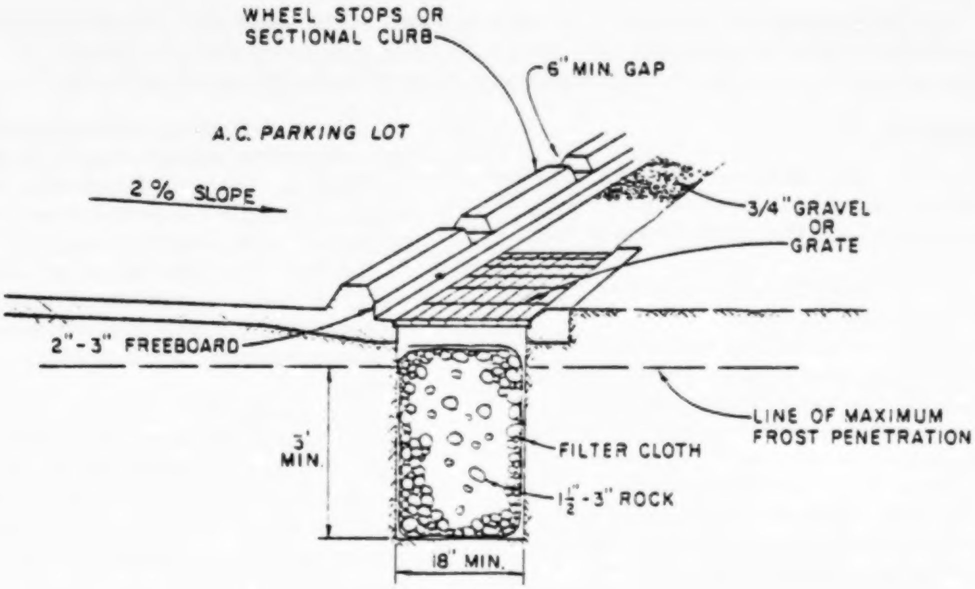
Figure 2
Pipe Outlet Sediment Trap
(Best Management Practices Handbook)


Flow
Excavate, if necessary for storage.
Earth embankment
Outlet protection

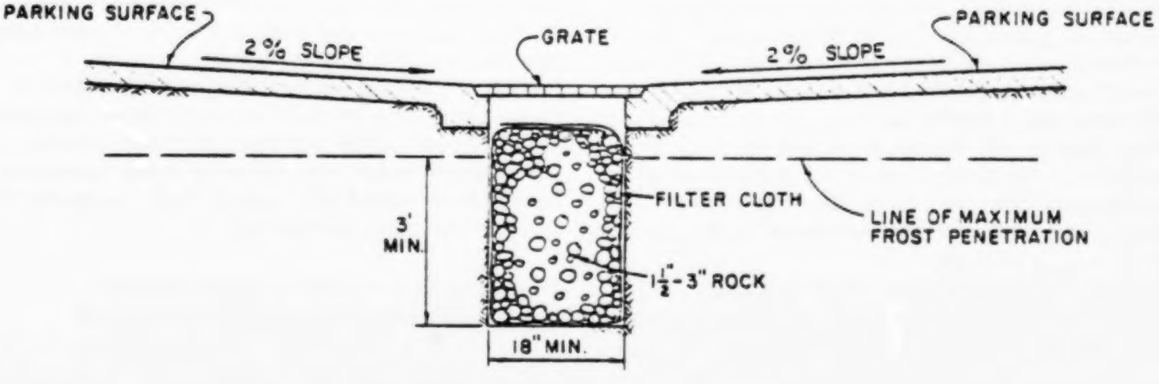

4'
All slopes 2:1 or flatter
1'-6" min.
5' max.
Perforated riser
Welded all around

EMBANKMENT SECTION THRU RISER

Figure 3
Typical Parking Lot Infiltration Trenches
(Best Management Practices Handbook)


WHEEL STOPS OR SECTIONAL CURB
6" MIN. GAP
A.C. PARKING LOT
2 % SLOPE
3/4" GRAVEL OR GRATE
2"-3" FREEBOARD
LINE OF MAXIMUM FROST PENETRATION
3' MIN.
FILTER CLOTH
1½"-3" ROCK
18" MIN.

LATERAL TRENCH
ISOMETRIC
no scale


PARKING SURFACE
2 % SLOPE
GRATE
2 % SLOPE
PARKING SURFACE
FILTER CLOTH
LINE OF MAXIMUM FROST PENETRATION
3' MIN.
1½"-3" ROCK
18" MIN.

INTERIOR PARKING LOT TRENCH
SECTION
no scale

Figure 4
Selected Policies and Administrative Guidelines
NWCCOG Water Quality Plan

3. ENCROACHMENT: The surface and ground waters of the region shall not be encroached upon by land uses or other human activities which could cause deterioration of water quality or impair the natural treatment processes provided by meadows and wetlands.

Policy Objectives

- To minimize the site disturbance on lands adjacent to surface waters and riparian environments.
- To minimize alteration and filling of stream channels.
- To minimize the occurrence of stream crossings by roads and other structures.
- To regulate mineral extraction, solid waste disposal, construction of sewage treatment systems, storage or processing of materials potentially injurious to water quality and all other land use activities in locations which would be detrimental to surface and ground waters and riparian environments.
- To establish a basis for public acquisition of critical stream encroachment zones through land exchanges and other available programs.

- Administrative Guidelines:

(1) Areas with existing encroachments—these areas should be studied further to determine their impacts on water quality. Results of those findings should be used to review individual county regulations in detail, to determine if revisions are needed. Such revisions may include designating certain encroachments causing water quality impacts as "non-conforming uses." Restrictions on such designated uses may include: (a) regulation to discourage future expansion of those uses, and/or (b) compliance with a pollution abatement order issued to require those uses to conform with adopted water quality criteria.

(2) Areas with no existing encroachments—

(a) Horizontal setbacks should be established for all stream channels, floodplains, wetlands, reservoir shorelines and other riparian areas. Setbacks should range from approximately 25 to 150 feet, to be determined on a case-by-case basis. Factors to be considered in establishing setbacks should include the following:

— soil permeability and erodibility
— slope
— cover conditions
— vertical distance above the stream channel.

(b) Maximum allowable departures of stream suspended sediments should be enforced, based upon the administrative criteria proposed by the Forest Service (Rosgen et al, 1977) and given on Table 3.4.

(c) Preferred land use and cover conditions for floodplains and riparian areas are presented in order of priority in Table 3.5.

(3) Modification of stream channel cross sections —encroachment activities including construction and earth movement shall be accomplished in a manner so as to maintain the same stream channel energy gradient upstream and downstream before and after modification wherever feasible.

(4) The feasibility of acquiring critical stream environment zones, floodplains, wetlands, or reservoir shorelines for public uses through land exchange programs, use of easements and other means should be further investigated with federal land management agencies and local landowners.

5. VEGETATION DISTURBANCE: The surface and ground waters of the region shall be protected by maintaining permanent vegetative cover and by controlling disturbances to vegetation.

Policy Objectives

- To enhance public knowledge of the importance of maintaining vegetative cover to protect water quality.
- To assist local governments by providing additional management tools to control vegetation disturbance.
- To establish criteria for review of vegetation clearance activity having potential water quality impacts.

- Administrative Guidelines: Table 5.5 presents suggested administrative guidelines for the ten planning and management areas.
- The eight types of general administrative guidelines proposed for the ten planning and management areas in the table are described below:

(1) Disturbance management plan: This plan should include a complete description of existing conditions, details of the vegetation disturbance activity (schedule, area involved, equipment to be used, etc.) and a description of all measures to be taken during and following disturbance to control water quality impacts.

(2) Timing of disturbance: Whenever possible, disturbances should be planned to occur at those times of year when water quality impacts will be minimized, as determined by seasonal weather conditions. Disturbances immediately prior to or during the winter season require particular consideration of the delayed period before the site can be revegetated. However, such impacts can possibly be mitigated, e.g., by logging during periods of snow cover to reduce ground scarification.

(3) Area controls: Consideration should be given to limiting the area of disturbance which occurs at any one time, particularly in locations where water quality impacts may be severe such as on moderate to steep slopes having slowly permeable soils.

(4) Silvicultural system and equipment: Methods of vegetation disturbance should be selected to minimize water quality impacts. Clear-cutting systems, for example, should be restricted to relatively small acreages in deep snowpack areas. Heavy logging equipment, for example, should be restricted on steep slopes where severe erosion hazards may exist.

(5) Stabilization during disturbance: Soil erosion controls and protection of surface waters should occur during the time of vegetation disturbance by using standard practices advocated by the U.S. Forest Service, the Colorado State Forest Service, and the U.S. Soil Conservation Service.

(6) Monitoring during disturbance: Regular inspections should be made of the disturbance site to insure that the operation is in conformance with the vegetation disturbance plan and that water quality impacts are being controlled to the extent possible.

(7) Post-disturbance monitoring: Inspections of the disturbance site after completion of the operation are necessary to insure that measures to control water quality impacts are effective and to determine if remedial actions are required.

(8) Water quality impact report: It is recommended that a water quality impact report be required as a supplement to the disturbance management plan for disturbance areas where water quality impacts may be severe.

6. SOIL DISTURBANCE AND EARTH MOVEMENT: The surface and ground waters of the region shall be protected from all land use and development activities involving soil disturbance and earth movement which would cause significant degradation of water quality or would impair the current or designated uses of the region's waters.

Policy Objectives

- To assist local governments in controlling soil disturbance and earth movement in locations where serious water quality impacts may occur.
- To protect public water supplies, fisheries and aesthetic values in streams and lakes within the region from adverse effects of soil erosion due to soil disturbance and earth movement.
- To regulate the adverse effects on water quality due to mining activities requiring movements of large quantities of materials.
- Administrative Guidelines: Table 6.4 presents administrative guidelines for the four types of planning and management areas identified for soil disturbance and earth movement. These are summarized below.

(1) Erosion control plans: Development activities involving soil disturbance and earth movement should be required to provide erosion control plans, depending upon the acreage of disturbance and the planning and management area within which they occur. Table 6.4 shows minimum acreages varying according to expected sedimentation hazards. The acreages given are judgmental and are intended to serve only as guidelines. Techniques employed in erosion control plans include requiring disturbed soils to be covered with mulch, topsoil and vegeta-

tion and requiring topsoil to be stripped and stockpiled prior to any grading for replacement before revegetation. (For an example see Pitkin County General Regulations, Section 5.71.09, Sedimentation Control.)

(2) Performance bonds: these are proposed as a means of insuring that erosion control plans are implemented. As shown on Table 6.4, they are indicated as "required" for planning and management areas encompassing relatively unstable level 1 landscape units, and "optional" on moderate to highly stable level 1 units.

(3) Cut and fill restrictions: Heights of cuts and fills are proposed as a means of limiting soil disturbance and earth movement on moderately to steeply sloping lands. However, it is proposed that height restrictions not be established until experience is obtained in using this form of control on development activities.

7. **IMPERVIOUS COVER:** The surface and ground waters of the region shall be protected from land use activities creating impervious cover conditions which would cause a long-term reduction of the quality and quantity of natural ground water recharge from precipitation.

Policy Objectives

- To control the development of new impervious cover conditions, particularly over ground water aquifers of existing or potential regional importance, to insure long-term yields of high quality water.
- To control the development of new impervious cover throughout the region to enable the maximum possible infiltration of precipitation and ground water contribution to streamflow during low flow periods.
- To recognize and protect irrigated agriculture as an important ground water recharge mechanism for sustaining stream flows during critical low flow periods.

- Administrative Guidelines: Regulation of impervious cover created as a result of construction of parking lots, buildings, roads, vegetation and soil removal, and other development activities, is recommended as described in Table 7.4. Maximum impervious cover figures presented in Table 7.5 are judgmental and subject to revision from further studies. They are based upon the following assumptions: (1) that they will not cause economic hardships to landowners, and (2) that they will help to insure ground water recharge in areas where development occurs. The greatest restrictions on impervious cover are proposed for ground water units of regional importance and areas of high precipitation, where ground water recharge will have the highest contribution to ground water supplies and base flows. Conversely, the fewest restrictions are proposed for ground water units which do not have regional importance and where precipitation is relatively low. The percentage impervious cover figures given should be administered as the "maximum allowable". The administering agencies should have the flexibility to require smaller percentages in situations where evidence suggest that the "maximum allowable" is too high.

8. **STORM WATER:** The surface and ground waters of the region shall be protected from land use activities which would alter the drainage patterns, velocities, volumes, and physical, chemical and biological characteristics of storm water runoff which would cause significant degradation of water quality or would impair the current or designated uses of the region's waters.

Policy Objectives

- To ensure that the aggregate of all development activities in the region will not cause storm drainage and floodwater patterns to exceed the capacity of natural or constructed drainageways.
- To regulate future development activities so that runoff volumes, and velocities after development will be similar to those occurring prior to development.
- To regulate future development activities so that provisions will be made, as required, for the storage, treatment and removal of pollutants to control their transport by storm runoff into streams, rivers and lakes.
- To ensure that mining activities provide for the adequate control and treatment of storm water, as required, so as not to be detrimental to existing water rights and to comply with all applicable wastewater standards.
- To encourage the use of non-structural controls in managing stormwater.

- Administrative Guidelines:

(1) Wherever needed, future development activities should be regulated to maintain hydrologic characteristics of the development site in its post-development condition similar to those of its pre-development condition. Similar hydrologic conditions should be defined as no increase in storm runoff volumes and velocities. Calculation of storm runoff volumes and velocities (before and after development) shall be performed using an accepted hydrologic calculation procedure. (For example, see Tahoe Regional Planning Agency, Hydrologic Calculation Procedures.)

(2) Storm water discharge (point source discharges, i.e., storm sewers) to surface waters from future development shall be regulated by requiring storm discharge permits for areas draining over five acres. Initial NPDES permits shall require periodic monitoring of storm runoff quality with effluent requirements established on the basis of results of further study.

(3) Further studies should be undertaken to determine the feasibility of requiring water quality impacts reports which address the quality of storm water from future developments, e.g., of over 25 dwelling units or new impervious cover exceeding approximately five acres.

(4) Planning and management areas proposed for this policy should be studied further to determine if any of the above administrative guidelines should be modified to reflect specific characteristics of different landscape units. If such studies are not undertaken, the planning and management areas should be used as a general information base for agencies responsible for implementing this proposed policy.

Once regulations are adopted in each county, NWCCOG staff will assist in future development proposal review. This approach will allow technical assistance to be delivered directly to the developer during early stages of implementation. This interaction will help in refining best management practices and regulatory mechanisms. It will also allow planning staff to directly monitor implementation in order to develop appropriate plan revisions, and to fine-tune the entire process.

Status

NWCCOG staff assistance is being directed to our six county governments first. This effort should provide a framework for municipal implementation during the coming year. The status of the county process is summarized here:

- Acceptance of management agency designation for nonpoint sources	6 counties
- Adoption of 208 plan as a portion of the county master plan	1 county
- Adoption of ten 208 plan policies as a portion of county master plan	1 county
- Regulations drafted	6 counties
- Staff regulation review complete	3 counties
- Best management practices handbook drafted	1 county

Conclusion

In summary, northwest Colorado is an area of high quality waters and extreme development pressures. To protect these waters from sedimentation and urban runoff, locally enforced control programs are being established. These programs seek to minimize administrative burdens for local governments. They also alert developers to the necessary controls early in the process. Early attention to project siting and design can eliminate additional requirements for the developer.

URBAN EROSION AND SEDIMENTATION CONTROL PLANNING IN PENNSYLVANIA

Richard E. Laudenslager, Soils Engineer
Department of Environmental Resources
State Conservation Commission
Pennsylvania

The legislative "backbone" of Pennsylvania's Erosion and Sedimentation Control Program is the Clean Streams Law. Originally enacted in 1937, it was amended in 1970. It allows the promulgation of Rules and Regulations for environmental quality. The Department of Environmental Resources (DER) plus two departmental boards; the Environmental Quality Board (EQB) and the Environmental Hearing Board (EHB) were created by amending the Administrative Code of 1929. Briefly, these three groups function similarly to the Federal system of "checks and balances"; the EQB, legislative; the EHB, judicial; and DER, executive.

Rules and regulations promulgated by the EQB are contained in the Pennsylvania Code, Title 25. The chapters dealing with "Protection of Natural Resources" run from 71 through 143. Chapter 102 addresses erosion control. Recent changes have been made to other chapters which significantly sharpen the focus on the issue of urban erosion and sedimentation control (E & S) in Pennsylvania.

Basically Chapter 102, Erosion Control, requires three things for all earth moving activities: prepare an E & S plan; have it on site of the activity; and use and follow the plan.

Three bureaus within DER are responsible for the program administration: the Bureau of Litigation and Enforcement (BLE), the Bureau of Water Quality Management (BWQM) and the Bureau of Soil and Water Conservation (BSWC). The BLE is self explanatory, the BWQM is a compliance oriented group with field staff spread throughout seven regional offices. The BSWC is a resources management group which provides assistance and technical advice to conservation districts and to other DER bureaus. This is a brief overview of Pennsylvania's present control program.

Currently the entire process of erosion and sedimentation control is undergoing a reevaluation and redirection as a result of several stimuli, but the main idea is to fine tune and refine the solid program as it began. It's an integration process of getting it all together. Key areas include: education; local decision makers; review process; post construction runoff, and implementation.

Let's start with how to get your message to the public. In Pennsylvania we believe that one of the most effective educational formats is public meetings and workshops. For the most part we work through the county conservation district.

Chapter 102 went into effect October, 1972. Many public meetings were held on this new and different subject, and were well received. But now, eight years later, how do we keep the educational ball rolling? Let me ask you. If we decided to hold a workshop and asked the district to mail out flyers stating,"An E & S Workshop to be held," and that's all we did, how many people do you think would show up? E & S isn't most people's priority. Let's face it! It may be ours, but it is not theirs!

How do we do it? We attract large groups by talking about other subjects; subjects they want to know about. For example, builders want to know about DER sewage disposal regulations; developers want to know what to look for buying a good piece of land; earthmoving contractors want to know about laws relating to underground utilities; engineers, etc. want latest design techniques and criteria. Give them what they want first, then tie in E & S.

One thing we try not to talk about is the law. We try to keep everything in a helpful and friendly tone especially for the conservation district. We have found that you can catch more flies with honey, than by chasing them with a stick.

Two other items of importance in the Keystone State are eats and entertainment. By eats I mean a formal dinner at the best restaurant, lunch at a vocational-technical school, a picnic, or a dessert meeting. One district even puts a keg of beer on tap for the contractors. By entertainment I mean movies, multi-media, slides, and abundant audio-visual aids; plus skits, field trips, personal testimonies, etc. Make them remember they came. Make them want to come back. I could go on but recapping education - it's tie it in with information they want; use positive approaches; and eats and entertainment.

Changing gears, let's discuss the review process. Looking back at Chapter 102 the regulations require all earthmoving activities to have a plan and some earthmoving activities need a permit (usually those over 25 acres but not farmers.) Who reviews these plans? Either DER or the conservation district. DER becomes involved in E & S reviews through the "Form 1" process. Applications for all DER permits such as industrial wastes, air pollution control, sewer extensions, etc. are reviewed at the DER Regional Office level to insure compliance with other applicable environmental Rules and Regulations, including E & S. No permits are issued without total regulation compliance. So an E & S plan must be included for all projects.

Conservation districts obtain plans to review through the E & S permit process; assistance to local municipalities; Title 25 requirements; and assistance to landowners or their representatives. Taking a closer look, applications for Erosion and Sedimentation Control Permits are made through the County Conservation District Office. After the plan is reviewed, recommendations are passed on to DER who issues permits.

Many conservation districts in Pennsylvania have written or verbal agreements with local units of government responsible for the Subdivision and Land Development Process. These municipalities submit plans to the district for review and comment. We are working to improve and expand this cooperation. The idea is local control for local situations. Assistance is available to the conservation district from DER and the Soil Conservation Service.

Recent changes to certain Chapters of Title 25 of the Pa. Code requires "a copy of a letter from the conservation district in the county where the project is located indicating that the district has reviewed the applicant's E & S control plan and considers it to be satisfactory." This statement or similar ones have been incorporated into Rules and Regulations for such things as Solid Waste, Strip Mining, and Water Obstructions. Definitely this raises the emphasis of E & S control in Pennsylvania, plus it increases the level of importance of the districts.

Implementation is seeing that the E & S plan is carried out on the ground. Some people refer to this as enforcement; we prefer not to. Yes, we have the legal authority; and, yes, we have to use it at times, but we prefer not to use an enforcement approach. The intent is to have a local person try through the use of friendly persuasion, actually professional salesmanship, to get the E & S plan installed. Webster defines "selling" as "to persuade or influence to a course of action." Assisting district personnel to enhance their "selling skills" is part of the program.

Compliance is checked in two ways; complaints and limited inspections. The key element of success has been a section of Chapter 102 which allows DER to assign certain administration operations and enforcement functions to districts. Presently twenty-six districts have negotiated agreements with DER. Many of these districts rely almost exlusively on the C.E.T.A. program for personnel and changes in Federal funding could significantly affect this portion of our program.

When does implementation begin? Before the streets are built? ... before grading? ... before the lots are laid out? We believe that the implementation phase of E & S control planning starts even before the first improvement is placed on paper. It should begin with a "natural systems inventory." What is the major stumbling block to environmentally sound growth? The environment has many subtle features that are difficult to distinguish and that are not always recognized by everyone making land use decisions.

What we in Pennsylvania are trying to do is get everyone to recognize that natural engineering techniques attempt to maximize the economic as well as the environmental benefits. Almost everybody should come out a winner. We're trying to get them at this point to communicate.

Usually a developer buys a tract of land and it is divided "cookie cutter" style without regard for streams, swales, slopes or soils. The subdivision process continues until suddenly someone stands up and states, "You need an E & S plan." It's too late. Obviously all the streets and lot lines are set up; the curbs and gutters are laid out; the storm sewer, sanitary sewer and water lines are designed. It really is too late! Probably the developer has already received preliminary approval from the municipality.

The implementation phase of E & S must start when you still have options open, especially to set aside the critical areas which are determined by an analysis of the natural systems inventory.

Let's drop back a minute and make sure we really know what we're saying. Do you realize that by asking builders and developers not to build on critical areas, we in the public sector are accused of literally "stealing" from them. Look at it from their viewpoint; if 10% of a 100 acre tract is "critical natural areas" and raw land costs are $5000 per acre, he's just been asked to donate $50,000. To make matters worse, those same ten acres once developed are worth more like $180,000. No wonder the private sector is upset!

Is there a way we can do both? Let's put ourselves in the shoes of the developer. You are driving down the road and you see a FOR SALE sign on a property in a nice area. What's the first thing you do? Check the soils map, right? Wrong! The first thing you look for is zoning, as a developer. What will "they," the municipality, let me do with this piece of land? Is it 5 acre residential or multi family?

This is usually how it starts in Pennsylvania. You find a piece of land, you get a zoning book, you look up the zoning for your tract; and you check the zoning requirements. This tells you the size you need to make your lots, Your "cookies." Are you beginning to see why many developers feel they are damned if they do and damned if they don't?

Let's look at the concept of Performance Zoning as prepared by the Bucks County Planning Commission, a major suburban county near Philadelphia. For those of you not familiar with Performance Zoning, there are three elements: Density, Open Space Ratio, and Impervious Surface Ratio. Each element directly ties into the principles of erosion and sedimentation control. Density simply means dwelling units divided by total acres. The distinct advantage for E & S is the ability to zone using a density requirement rather than an area requirement which allows the developer to preserve the critical natural areas and still get the same number of dwelling units. Open Space Ratio needs no definition. The most important erosion control principal is reduce the size of the area exposed which this does beautifully. Certainly the aesthetics created add to property values. Impervious Surface Ratio refers to the percentage of "waterproofing" which has been planned for the site. This definitely plays an important part in managing post construction runoff for erosion control.

Let's take a site and look at conventional zoning versus performance zoning. Conventional zoning is the typical cookie cutter subdivision. Statistically the density achieved is 72%, Open Space Ratio 3%, and Impervious Surface Ratio 15%. Performance Zoning looks different. There are many positive aspects besides the statistics but let's look: density 76% (about the same), O.S.R. 84% (drastic increase), and I.S.R. 5% (significant reduction).

Obviously for more reasons than just E & S control, Performance Zoning looks good; but what about that zoning book and all those requirements. How do you convince all those local officials? A developer can prepare the best plan in the world and still have it rejected by local officials. This is the crux of the problem and this is where we in Pennsylvania are working. This brings us to the next topic; working with local decision makers.

In Pennsylvania the major piece of land use legislation is Act 247, the Pennsylvania Municipalities Planning Code. It covers zoning, subdivision and land development, PRDs, and comprehensive planning. Major governmental control exists at the municipal level not the county level. There are approximately 2600 municipalities within our Commonwealth. You can see we have our job cut out for us.

What methods are used to build rapport with these Local Decision Makers? First, we rely heavily on districts. We assist them with formats, audio-visual development, technical information, plus any other back up that they may need. Take a look at some of the things we've tried:

(1) County wide programs for township supervisors and borough officials.
(2) Securing 15 minutes on their local meeting agendas at their regularly scheduled meeting. (A local "road show"; slides and services, etc.)
(3) A breakfast meeting for code enforcement officers and road supervisors. Talk about ways to directly help them with their problems.
(4) Contact key officials in key municipalities. Work with them to solve one problem dealing with a roadway, drainage, or localized flooding. Build up their confidence in the district, slow and easy.
(5) Supply key speakers for a county wide or state wide meetings of officials.

We in Pennsylvania, must recognize one fact; local officials are being bombarded with programs and requirements from all sources. These part-time officials are overwhelmed. We try to put ourselves in their shoes and make it relevant to their needs.

Now once we have their attention we try to establish a working relationship with their county conservation district to have subdivision plans reviewed for E & S. Also we encourage the municipality to use the conservation district to mediate erosion, sedimentation, and stormwater complaints that arise.

The next step is to assist the local officials in incorporating E & S criteria into their ordinances. This can be done in two ways; either they can draw up a separate erosion and sedimentation control ordinance, or they can modify existing ordinances. We'd suggest they incorporate E & S into already existing structures so that it can't get lost in the shuffle. Just because a municipality has an E & S ordinance, doesn't mean they will use it. This happens all the time. If it is part of the S&LD ordinance, building code, etc.; they usually do, however.

So, we try to start slowly with municipalities, build their confidence in the District, show them how we can help, then get into the nitty-gritty at their pace. By the way, one of our answers to constrictive zoning requirements is Planned Residential Development (P.R.D.) ordinances or amendments.

Finally let's discuss post construction runoff. Obviously by management of post construction runoff we're talking about storm water. Everyone knows what stormwater is - right? Wrong! I like the way the joint report on residential stormwater management (U.L.I., A.S.C.E., & N.A-H.B.) puts it. "An area of concern as complex as that of stormwater management defies translation into simple terms that would be easily and completely understandable by all audiences."

The most important aspect of stormwater management is making certain everyone is talking about the same thing. Let me explain the types of things we see in Pennsylvania. Now we find it very difficult to separate stormwater from erosion and sedimentation control. Uncontrolled stormwater runoff causes erosion which results in sedimentation; it is a cause effect relationship. Therefore to treat erosion you must treat the cause ... stormwater. Other misunderstandings result from relation of stormwater to water quality versus water quantity. Legally, there is a problem sometimes between on site and offsite stormwater. I don't think you can tie up everything into just one ball of wax. Stormwater is definitely confusing at best, to most people.

One year and eight days ago our government brought forth on our Commonwealth a new Act, Stormwater Management. It attempts to deal with all the aspects discussed above, but focuses on watershed plans which are to be prepared on a county wide basis. After these plans are prepared, approved, and adopted; each municipality shall adopt or amend, and implement such ordinances, regulations, etc. as necessary to regulate development in a manner consistent with the watershed plan. We feel that this is a giant step in the right direction, especially since the county conservation district is named in the law to serve on the watershed plan advisory committee.

Act 167 also requires that persons engaged in the development of land shall implement measures that either: assure that the maximum rate of stormwater runoff is no greater after development than before; or, manage the quantity, velocity and direction of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury. What I believe the act is allowing, is flexibility in reshaping the post construction hydrograph. This is important. We;ve seen situations where the stormwater cure was worse than the disease.

If you will, consider some aspects of stormwater management which we are exploring. Certainly manipulating the hydrograph is very interesting and the problems are real, but let's take a look at two other major problems of stormwater from a "field" viewpoint. I'm speaking about DUMPING; dumping excess soil and water in the "wrong" places. This aspect, we're learning, is at least as big as the hydrograph problems. First I'm talking about encroachments on floodplains of streams and natural swales, and areas of intermittent concentrated flow. This results from filling and grading operations, and even building structures. In any event, it places restriction on flow out of the watershed. It creates a "pressure point" which causes a situation similar to hardening of the arteries. Seventy-five percent of the complaints I investigate for DER are a result of encroaching on natural drainage systems. Remember "it's not nice to fool with Mother Nature." Hopefully Pennsylvania's new floodplain management legislation will eventually help to control this!

The second "dumping" problem is legally defined as "artificial collection and concentration of runoff." Consider if you will, strip development of houses along a road. Behind these houses is a long sloping hillside that has been purchased for development. Runoff from this field is a natural condition flowed in "sheet" fashion into the back yards of these homes with no problems. Now, however, add streets, parking areas, buildings and driveways and see what happens to the runoff. It is artificially collected by roof gutters and down spouts, curbs, and concentrated into drainage systems. If the area does not have storm sewers it usually, right or wrong, is dumped on the next lower property. So the rest of the calls to DER deal with artificial collection and concentration.

We've found that these problems of dumping are really the major cause of stormwater problems and this is where local watershed plans in the Keystone State will help.

So there you have it, Pennsylvania's Erosion and Sedimentation Control Program, and our new directions: education, review processes, implementation, local decision makers, and stormwater. Through a lot of team effort, we are growing to realize the goal of improved water quality.

As you can see we're placing emphasis on cooperation rather than confrontation, and we are working solidly with conservation districts and local decision makers. Sometimes doing a good job with E & S is like wetting your pants while wearing a black suit ... it gives you a warm feeling inside but nobody notices. In Pennsylvania we think people are beginning to notice.

NEW RESPONSIBILITIES IN URBAN EROSION AND SEDIMENT CONTROL
THE MARYLAND EXPERIENCE

Harold E. Scholl
State Resource Conservationist
USDA Soil Conservation Service
College Park, Maryland

It is a pleasure for me to extend greetings to you from your Maryland soil conservation friends. I also appreciate this opportunity to hear what others have experienced in this challenging new program.

A few years ago while camping in Canada, I stopped at a small country store. "Do you happen to have a mantle for a gasoline lantern?," I asked the matronly clerk. She sternly replied, "We don't happen to have them! We stock them on purpose!"

The 1970 Maryland Sediment Control Law didn't just happen. It was caused by a combination of many factors including highly erodible soils and geologic materials, intense urban growth, the historic and endangered Potomac River, and the proximity to our Nation's Capital!

The following events were especially important.

1961 - Maryland's Attorney General ruled that sediment is a pollutant under state water quality laws.

1967 - The Montgomery County Council made erosion and sediment control mandatory through an amendment to subdivision regulations. Soil conservation districts (SCDs) were given the technical authority to recommend control measures which developers must agree to carry out to receive clearing and grading permits and to have their plat recorded.

1967-69—Prince Georges, Baltimore, Anne Arundel, and Howard Counties used Montgomery's "task force" approach and adopted similar programs.

1969 The Patuxent River Watershed Sediment Control Law was enacted affecting parts of seven counties in the 560,000-acre area. It required any earth changes, except for agricultural practices and single family residences on more than 2 acres, to have prior approval of SCDs so that erosion and siltation would be controlled.

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1970 - On April 22, Earth Day, Governor Mandel signed House Bill 1151, the 1970 Sediment Control Law, which replaced the Patuxent law and extended its principles statewide. Under the leadership of the Department of Natural Resources (DNR) and with assistance of SCDs, this new law gave counties until March 1, 1971, to enact ordinances requiring SCD-approved sediment control plans prior to issuing building or grading permits.

1971 - On April 6, Maryland's Attorney General ruled that "protective stormwater measures may be required by the Soil Conservation Districts" under the 1970 Sediment Control Law.

I suspect that many of you have seen a copy of Maryland's Sediment Control Law but let's recall the key features. The major provisions of the Sediment Control Law are:

1. Counties and municipalities are required to develop a sediment control program and the procedures and ordinances necessary to implement and enforce it.

2. Exempt are agricultural land management practices, construction of agricultural structures, and construction of single-family residences on lots of 2 or more acres.

3. DNR has leadership in assisting local governments, including SCDs, in their responsibilities under the law. Also, DNR must review and approve all land clearing, soil movement, and construction projects by any state or federal agency.

4. No grading or building permit may be issued until the developer submits a grading and sediment control plan, approved by the SCD, which he certifies he will follow.

5. Violation is deemed a misdemeanor and subject to a $5,000 fine or 1 year in prison.

It seems to me that the counties and municipalities accepted the responsibilities assigned by the state law largely because of their confidence in SCDs and the helpful attitude of DNR's Water Resources Administration (WRA). This is illustrated by the principles adopted to guide the state sediment control program:

1. The statewide program is based on legislative requirements and guidelines established by state law.

2. WRA pursues a policy of mutual cooperation and effective use of existing county, state, and federal units of government.

3. Each county and municipality adopts sediment control ordinances and serves as the primary units of government for administration, inspection, and enforcement. The goal is local control with the state assisting in a back-up role.

4. WRA and local governments use the SCD as a technical advisor for erosion and sediment control.

5. The program is fully integrated with WRA's other pollution control activities.

6. The program is oriented towards information, education, training, research, and prevention.

I'd like to share with you some of the helpful activities that were carried out on the basis of these principles.

In June, 1970, just prior to the July 1 effective date for the new law, a series of five regional meetings were called by then secretary of DNR, former Governor J. Millard Tawes. These were planned and held in cooperation with the Water Resources Administration, Maryland Association of Soil Conservation Districts, and Soil Conservation Service.

The purpose of the meetings was to brief SCD supervisors, county governing bodies, and SCS personnel on the law. The county governing bodies were instructed to set up a local, broadly based sediment control task force to develop and recommend a county sediment control program. They were also asked to name a representative to serve as a contact with WRA. Attendance and participation were excellent contributing to the statewide acceptance of local responsibilities.

On September 16, 1970, a seminar was sponsored by WRA and SCS to orient professional engineers, landscape architects, land surveyors, developers, and others to the new law and to "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas."[1] These standards were developed and compiled by SCS and Maryland SCDs through an interdisciplinary task force approach including members of the private sector. More than 400 persons participated in the seminar, adding to the acceptance of technical guidelines throughout the state.

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[1] USDA Soil Conservation Service, November 1969, College Park, Maryland

The following January, DNR sponsored a workshop with SCS assistance. Its purpose was to orient and train public works inspectors, building inspectors, grading inspectors, utility inspectors, and other county employees in the technical details of sediment control plans and measures. Again, there was excellent response and participation.

There isn't time to enumerate the many other meetings and conferences that helped achieve the end results. Within one year, all counties, Baltimore City, and several municipalities developed sediment control programs and enacted the necessary ordinances and procedures. Public and private agencies such as the State Highway Administration, Baltimore Gas and Electric Company, Washington Suburban Sanitary Commission, and others also developed sediment control programs to guide their operations.

This new program in Maryland has placed great demands upon SCS for technical assistance since SCDs have given high priority to this work. In meeting this need SCS has maintained close relationships with DNR.

For the next few minutes I will briefly review seven important technical principles for control of erosion and sediment upon which technical standards and assistance are based.

1. Expose the smallest practical area of land.

2. Expose for shortest time possible.
   In Maryland, rainfall is fairly evenly distributed throughout the year, however, only 25 to 40 percent of the total rainfall produces 50 to 75 percent of the erosion. This occurs, of course, during the active construction period when the land (if not protected) is most vulnerable.

3. Temporarily stabilize critical areas with vegetation or mulch.

   A practical application of this principle is seeding graded areas while streets and utilities are being installed and before building construction begins.

4. Install and maintain sediment traps. This well-known technique can be compared to a goalie in a hockey game—it keeps the silt that has passed all other defenses from scoring offsite!

5. Accommodate increased runoff.
   This could mean stabilizing the channel by vegetative or structural means or temporarily storing increased runoff on or off-site. In Maryland, we call this storm water management.

6. Establish permanent vegetation and structures as soon as possible.

7. Fit the development plan to the topography and soils. The "Land Development Manual," published by the National Association of Home-Builders, reminds us that "the time to begin control of siltation and sedimentation is at the beginning. This beginning is in land acquisition."

   When the land is fully taken into account as a foundation for development, solutions can be built into the plan and design.

The transitional change in land use is like making an incision into one part of the human body. The surgical technique requires interdisciplinary study and cooperation in planning and execution. If aseptic conditions and other preventive measures are not a part of the procedure, the multiplying effects of "bacteria rainfall" can result in the primary infection known as soil erosion. This in turn can spread to related bodies of land or water causing the secondary infection known as sedimentation.

Maryland's new sediment control law has altered the surgical procedure for operating on the landscape. It is accelerating application of the principles of erosion and sediment control.

How does SCS technical assistance figure in the SCD's sediment control planning process? SCS provides assistance during each stage of development.

1. Land acquisition stage. Soils information and interpretations are provided to developers on a consultive basis before they purchase the land or develop the plan. Fortunately modern soil surveys are available for all of Maryland.

2. Preliminary planning stage. The county planning commission, the developer, or his consultant can forward preliminary plans to the SCD for SCS review and comment. SCS, through the SCD, may present written or oral comments to the developer or consultant or at the meeting of the subdivision review committee. This committee includes representatives from county departments of transportation, water, sanitation, health, recreation, education, planning, and zoning.

SCS comments alert those concerned to the severe soil limitations for the planned development, to special inherent problems such as those related to offsite drainage through the site, and the erosion and sediment control problems peculiar to the type of development planned. Alternative solutions, as well as sediment control and storm water management requirements that the developer is expected to install, are also discussed.

3. Preconstruction stage. SCS provides technical advice, by appointment only, to the developer and his consultant (and possibly the representative of a county agency such as public works) on basic concepts for sediment control and storm water management in the plan to be submitted for approval.

   A final review of the plan, by appointment only, is provided to determine compliance with the SCD's standardsand specifications. As developers and consultants gain experience, this can be accomplished at an earlier meeting.

   The official copy of the sediment control plan must be certified as follows:

   a. The consultant must certify that the plan was prepared in accordance with the SCD's "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas."

   b. Developers or builders must certify that all clearing, grading, construction and development will be done pursuant to the plan.

   c. SCS certifies the plan meets technical specifications.

   d. The SCD approves the plan.

4. Construction stage. A designated county agency such as that for public works, inspections and permits, or environmental control is responsible for enforcement through its inspectors.

   SCS, through SCDs, provides consultive assistance and training to inspectors charged with enforcement. This is carried out discreetly so that neither SCS nor the SCD erroneously appears to have an enforcement role.

5. Information, education, and evaluation. SCS assembles data and pictures relating to erosion and sediment control. Through SCDs, it participates in special studies by county and state erosion and sediment control task forces and evaluates the technical and procedural operations of the program.

Maryland's experience indicates there are certain key concepts and principles essential to a successful program. Many of these were recognized by Mr. Edward R. Keil, former SCS State Conservationist, and other pioneers in the Maryland program. They are:

1. Top level elected officials must understand erosion and sediment control problems and adopt a sediment control policy.
2. The responsible government should appoint a task force, composed of people knowledgeable of the problems and solutions and those likely to be affected, to study the problem and draft the program.
3. The program must be adopted and supported by the responsible government.
4. Legal back-up and supporting executive orders and legislation are essential.
5. A good information and education program is key to public and industry support.
6. Orientation and training should be held before the program begins and should be maintained throughout.
7. Adequate and competent personnel must be available for plan review and enforcement.
8. Plan reviewers and field inspectors need to learn from each other.
9. The responsible level of government must periodically evaluate the program using the task force approach.
10. Allow for creativity and flexibility.

What is the current status of the Maryland program? The most recent review and evaluation, released early in 1977 by the Maryland Water Resources Administration, showed the following:

"Ninety-five municipal programs are acceptable and 54 are unacceptable. Nineteen county programs are acceptable and 4 are unacceptable. Two state agency programs are acceptable and 1 is unacceptable. Across the state, inspection and enforcement appears to be the weakest link in most of the sediment control programs due to 1) a lack of manpower; 2) a lack of proper training; and/or 3) a lack of administrative support or consistent administrative policy at all levels."

Two actions have been taken to address the training needs. (1) The Water Resources Administration has developed a 13-lesson audiovisual training program to provide inspectors and others a thorough background in the theory and practice of sediment control. (2) Senate Bill 1204 has been enacted. It requires the applicant for approval of an erosion and sediment control plan to certify that responsible construction personnel have a certificate of attendance at an approved training program. This requirement becomes effective July 1, 1980, and training programs will begin this winter.

While manpower continues to be a problem, this review indicated that more than 250 local, federal, and state agency people worked in the program involving more than 100 man years of work.

As a part of the review, the responsible governments received many recommendations for improving their programs including ways to strengthen administrative support.

Most recommendations from the last review are being carried out and a new review is underway.

The Maryland program continues to be innovative and evolving. For example, stormwater management is becoming a new and important part of the program. Begun in Montgomery County, it is now required in more than 10 counties by SCD policy, county executive order or ordinance, or it is accomplished by jawboning on a site-by-site basis. With assistance of SCS, the Maryland Association of Soil Conservation Districts has published a "Stormwater Management Pond Design and Construction Manual." The Maryland Water Resources Administration is looking ahead to a statewide stormwater management program and has a design manual scheduled for release by 1981.

Hugh Bennett, founder of the Soil Conservation Service, commenting on the mismanagement of farm lands across the nation and the conservation program needed stated in 1939, "We are simply retracing our steps across this land in a march of agricultural conservation."

I believe he would now say, "We are simply retracing our steps across this land again in a march of urban conservation."

While this new march is both forced and disciplined, fortunately it retains a pioneering spirit of excitement, anticipation, and challenge. And, it seems so very fitting for it to have started in historic Maryland and Virginia.

We in SCS are proud to be marching with you in this national conference here in Minnesota!

THE VIRGINIA EROSION AND SEDIMENT CONTROL PROGRAM

Gerard Seeley, Jr. P. E..
Chief Engineer
Virginia Soil and Water Conservation Commission
Richmond, Virginia

In Virginia we have about six years of operating experience under our State Erosion and Sediment Control Law. Rather than recall the circumstances and events which led to the passage of the Law, or dwell upon specific provisions of the Law itself, I will focus on the current operation of our statewide program and discuss some of the major problems we have encountered and some approaches we have taken at the state level to improve our overall program effectiveness.

Background Information

Our 1973 state law mandated that every county, city and town in Virginia be covered by an approved local erosion and sediment control program. Consequently, we have 172 separate local programs most of which were adopted and are administered by local governments. A few are administered by soil and water conservation districts where a locality failed to adopt a program of its own.

Although there is a wide variety of local program structures and administrative procedures, the basic concept of operation is consistent statewide. Each local program contains three essential elements: plan review, inspection and enforcement. Anyone wishing to undertake a regulated land disturbing activity must first prepare an erosion and sediment control plan for the project and submit it to the appropriate plan approving authority. During construction, the local government or conservation district is responsible for conducting periodic inspections to insure that the approved plan is properly implemented and is effective in controlling erosion and sedimentation. If a violation is found, the locality must take appropriate action to enforce the provisions of the Law.

As in most states with similar programs, our erosion and sediment control law is aimed at urban construction. Most construction projects which disturb greater than 10,000 square feet must have an approved erosion and sediment control plan. Of course, there are certain types of land disturbance which are exempt from the Law. Major exemptions in Virginia include electric and telephone utility line construction; agricultural tilling, planting and harvesting operations; forestry; surface and deep mining; construction of single family dwellings (not in subdivisions); and individual home landscaping or gardening; among others. Projects on federal lands are also currently exempt under our law. Projects of state agencies and institutions are exempt from local control, however, these are subject to review an approval by the Virginia Soil and Water Conservation Commission.

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The task of coordinating all of the local programs and establishing minimum statewide standards and criteria for controlling urban erosion and sedimentation rests with the Virginia Soil and Water Conservation Commission. The Commission is a small state agency with only 21 total classified positions. The erosion and sediment control responsibilities are carried out primarily by a technical staff of four engineers and two conservation specialists located in Richmond. The task of coordinating 172 programs with six staff members from a central location is quite challenging. However, with the cooperation of many local governments, conservation districts, and the private sector, Virginia has come a long way toward implementing an effective statewide erosion and sediment control program.

Of course, we have encountered a number of difficult problems and we are a long way from controlling erosion and sedimentation at a satisfactory level on a statewide basis. However, we are taking what we consider to be some innovative approaches to overcome our problems. I would like to share some of our experiences with you.

The Funding Problem

While our state law mandated that each locality be covered by an approved local erosion and sediment control program, it did not provide any funding for such programs at the local level. This is a primary source of concern among local governments, particularly in localities with small populations and limited tax bases.

In the large urban localities, such as Fairfax County, which is adjacent to Washington, D.C., there is little problem incorporating erosion and sediment control regulations into their already sophisticated site plan review process. The public demand for such a program is high in these areas and sufficient funds are usually available through local tax revenues to support the program.

The majority of localities in Virginia, however, are more rural in nature. Land development in these areas is on a much smaller scale. Local governments have a difficult time justifying the expenditure of limited local tax dollars to support a program which does not have a very high public priority. Nonetheless, the Law does not distinguish between localities. A land development project, even in a rural area, can cause significant damage to public and private property and contribute to water pollution and stream degradation. Therefore, each locality regardless to size is expected to gear up and administer their program as best they can.

Although the legislature has provided no state funding for local erosion and sediment control programs, they have recognized the problem and have provided localities with a potential revenue source for this purpose. The State Law was amended in 1978 to allow localities to charge a maximum $150.00 fee for reviewing plans and conducting inspections. These fees are paid by those who submit plans to disturb the land. The idea here, of course, is that whoever creates the problem should pay the cost of program administration. This is a reasonable concept in theory but does not really apply in practice.

First of all, many localities welcome new development and hesitate to impose these new regulations, let alone charge fees which might further discourage it. Consequently, many jurisdictions have chosen not to charge any fees at all. Those that do charge fees generally keep them so low that they do not cover much of the cost of program administration.

According to a 1977 survey by the Commission, localities recover less than 45% of their program costs through plan review and permit fees on a statewide average. Among the less urban localities, which review less than 100 plans per year, the average cost recovery was only about 18%. The obvious conclusion is that most local programs are funded primarily through general tax revenues. This situation is likely to continue even with the amendment to the Law allowing localities to charge fees.

The problem of funding local erosion and sediment control programs at an adequate level will not be overcome easily. Localities will likely continue to fund these programs at a level they feel is justified by local priorities. Fortunately, localities which have the greatest amount of land development generally place a higher priority on their program because of greater public demand.

The Training Problem

Even if all local programs could be funded at an adequate level, it is not likely that the problem of erosion and sedimentation from urban construction would suddenly be overcome. A much more pervasive problem is the shortage of people who are qualified in the field of soil and water conservation and more specifically in the very new field of urban conservation.

Consider for a moment the number and types of people who are directly affected by this relatively new program. Private engineers and architects must prepare erosion and sediment control plans to meet certain minimum standards and criteria. Local officials must then review these plans and judge their adequacy. Land developers and contractors must be able to read and interpret approved plans and apply the necessary control measures on the ground, and finally, local inspectors must be able to determine if the plan is being implemented properly and is effectively controlling the problem. There are literally hundreds of persons in Virginia who are expected to apply basic soil conservation principles on a regular basis and who have received virtually no formal training in this field.

The main problem is that this type of training has simply not been available. In the past, soil and water conservation has been considered primarily an agricultural concern, and the only college curricula which offer this type of training are usually agriculturally oriented. There has been virtually no opportunity for engineers, architects or land developers to obtain soil conservation training in their respective fields. Thus, it is not hard to understand why there is a severe shortage of qualified people in this area.

The Virginia Soil and Water Conservation Commission has identified this problem as a major obstacle to achieving an effective statewide erosion and sediment control program. Consequently, one of our primary objectives is to establish a statewide educational program which will make erosion and sediment control training available to those who need it.

Community College Courses

Our first strategy to accomplish this objective was the development of two erosion and sediment control training courses. One course is designed for engineers, architects and planners who must prepare or review conservation plans; and the other course is for job superintendents and inspectors who are responsible for application of control practices on the ground.

In 1976, text books were developed specifically for each course and with the cooperation of the State Community College System, these courses were incorporated into the statewide community college curriculum. The courses can now be offered at any of the 22 community colleges in Virginia where sufficient local interest is expressed. The Commission has so far been able to supply text books and other training materials at no charge to the students. To date, we estimate that over 300 people have taken one or the other of these training courses and have received three college credits in the process.

Statewide Training Seminars

Recognizing that many people who need this type of training do not have the time or inclination to attend college courses, we have begun working on a second strategy; that of conducting periodic statewide training seminars. We made our first attempt at producing such a seminar in March of this year.

Our first training seminar was designed for local officials. We invited representatives of all local programs to attend a two-day training seminar on the Virginia Erosion and Sediment Control Program. In order to reduce travel expenses and keep attendance at a manageable level, we decided to divide the State in half and conduct two separate seminars. The seminar agenda included presentations and open discussion on the State Law and local program administration as well as a number of sessions on the technical aspects of program implementation. A total of 181 participants attended the two-day seminars. According to the written evaluations we received from the participants, the seminars were highly successful and should be continued on a periodic basis. In the future, we hope to expand our seminar programs to include the private engineers, architects and land developers.

Local Program Reviews

Although our statewide educational programs have been quite successful, we have found that they do not totally satisfy the informational needs of local officials who are administering erosion and sediment control programs for the first time. Our state law is quite complicated and local officials who do not interpret or implement it properly generally have great difficulty operating their programs effectively.

To address this problem, the Commission has initiated a local administrative review program. Under this program, a team of two Commission staff members will visit a locality and meet with all of the local officials involved with program administration.

Each program is reviewed in two parts. The first part consists of an interview session during which the administrative aspects of the program are examined and discussed. The second part consists of a field trip to determine if conservation practices are being applied adequately to construction sites in the area. After the meeting, the Commission prepares a report to the locality outlining the strengths and weaknesses of the local program and making recommendations to improve program effectiveness. Local programs which are found to be operating below minimum state standards are scheduled for a second review within six months to a year.

To date, we have conducted 30 such local program reviews. Our goal is to review each of our 172 local programs within a five-year cycle. So far, the feedback from local officials seems to indicate that these program reviews are very successful and should be continued.

Improved Technical Publications

In addition to our statewide education and local assistance programs, we have been working to develop better technical publications which will be more understandable and useful to the people who must function under the Law.

In 1977, we developed a "Directory of Erosion and Sediment Control Products and Equipment". This publication provides a categorized listing of commercially available products and equipment which may be used on construction sites to control erosion and sedimentation. The names and addresses of product manufacturers and suppliers are also included so that interested persons can send for additional product information.

In 1978, we developed a publication entitled "Preparing an Erosion and Sediment Control Plan for a Construction Project - A Recommended

Step-by-Step Procedure". The purpose of this publication is obvious from the title. This booklet has proven so popular that the original printing of 1,000 copies was exhausted within six months. A second printing of 1,000 copies was necessary.

This year, our major project has been the revision of our original 1974 State Erosion and Sediment Control Handbook. The revised handbook, which is scheduled for publication in 1980, will contain updated standards and specifications for erosion and sediment control practices. The new handbook will contain more diagrams, pictures and step-by-step design procedures then the original handbook. It will also be written in a more "educational" style to help the user better understand the technical standards.

An innovative concept which will be incorporated into the new handbook will be the establishment of "General Criteria for Controlling Erosion and Sedimentation from Land Disturbing Activities". These "General Criteria" will set forth standards of conservation practice which must be met on all regulated land disturbing projects. They will specify clearly where and when certain erosion and sediment control practices are to be employed. With these "General Criteria", local officials, engineers, architects and land developers will be able to better determine what is an acceptable level of erosion and sediment control on a land disturbing project.

Communication

Another important aspect of our implementation program involves communication. We have found that a statewide regulatory program of this scope requires a mechanism for regular information dissemination.

To fill this need, the Commission publishes a quarterly newsletter entitled "The E&S Bulletin". The purpose of this publication is to establish a communication link between the Commission and persons who are affected by the Law. It is used to keep readers informed of recent developments in the field of urban conservation, proposed or actual changes to the State Law, educational events and information, and other current items of interest. Readers are encouraged to supply ideas for articles or to comment on or question previously written articles.

The E&S Bulletin is currently distributed to about 2,000 persons. The mailing list includes local government officials, conservation district directors, private engineers, architects and contractors, other state agencies and institutions, and a number of private citizens who have expressed an interest. Anyone may be added to the Bulletin mailing list by making a written request to the Commission.

Conclusion

On the whole, we feel that Virginia has made significant progress in the field of urban erosion and sediment control. Our state law has provided the impetus and has established a good framework for a successful statewide program. However, as I stated earlier, we still have a long way to go.

At the state level, we see our role as one of providing guidance and direction. We plan to continue our statewide educational efforts and to provide direct technical assistance to local governments and conservation districts to improve the effectiveness of local programs. Regardless of what we do at the state level, however, we recognize that the real key to success lies at the local level. Until the local officials, land developers, and the general public become convinced that erosion and sediment control is needed, reasonable and worthwhile, only limited success can be achieved.

In Virginia, there are increasing indications that people are beginning to understand the benefits of urban conservation. Local programs are beginning to function more effectively, conservation practices are becoming more evident on construction sites, and more people are beginning to participate in erosion and sediment control training programs and seminars. We are optimistic that in time our program will gain wide public acceptance and we hope that erosion and sediment control will ultimately become a routine part of the land development process in Virginia.

THE NEW JERSEY EXPERIENCE IN CONTROL OF URBAN SOIL EROSION AND SEDIMENTATION

Samuel R. Race, Coordinator
Soil and Water Conservation Service
New Jersey Department of Agriculture
and Executive Secretary, State Soil Conservation Committee
Trenton, New Jersey

New Jersey has the dubious distinction of being the most densely populated State in the Nation. With over 1,000 persons per square mile, the pressures of development and urbanization are intense. While these development pressures are experienced throughout the State's twenty-one counties, the Development impact is further emphasized by surveys which have shown that two-thirds of the State was still classified as open space only a few years ago.

These development pressures were recognized in the early seventies by soil conservation leaders as the cause of a severe soil erosion and sedimentation problem. High priority was placed upon the development of a program and mechanism to control the problem. In response, the State Soil Conservation Committee, which is a unit of the State Department of Agriculture, established in 1972 a State Sediment Control Task Force. Membership of this group included virtually all groups, organizations and agencies which were affected by or concerned with land development and erosion control.

The task force findings and recommendations led to several important actions, including the development of uniform State Standards for Soil Erosion and Sediment Control and model ordinances for use by municipalities which had the authority to require land use controls.

With the outstanding assistance of the U.S. Soil Conservation Service, the Standards were developed, adopted and published by the State Soil Conservation Committee and distributed through the local soil conservation districts to all 567 municipalities in the State. Educational programs were conducted to encourage municipal adoption of ordinances enforcing use of the Standards to control erosion on major developments. This educational and voluntary approach resulted in positive action by approximately one-tenth of the municipalities. Interest was keen at the onset but slowed after a year or more of exposure.

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The State task force had recognized this possibility and recommended that a model state law be prepared which would mandate erosion control throughout the State if the voluntary approach did not work. A drafting committee was established with representation from all interest groups including the construction industry and the State League of Municipalities.

Completed in 1974, the proposed legislation was introduced in the Senate with bipartisan sponsorship. The original draft included several options for home rule enforcement ranging from total soil conservation district enforcement to municipal exemption from district jurisdiction with State approval of municipal ordinance provisions. It also included substantial State funding to get the program started.

The findings of the Legislature as written in the preamble to the bill are significant. Section 2 stated that "The Legislature finds that sediment is a source of pollution and that soil erosion continues to be a serious problem throughout the State, and that rapid shifts in land use from construction of housing, industrial and commercial developments, and other land disturbing activities have accelerated the process of soil erosion and sediment deposition resulting in pollution of the waters of the State and damage to domestic, agricultural, industrial, recreational, fish and wildlife, and other resource uses. It is, therefore, declared to be the policy of the State to strengthen and extend the present erosion and sediment control activities and programs of this State for both rural and urban lands, and to establish and implement, through the State Soil Conservation Committee and the Soil Conservation Districts, in cooperation with the counties, the municipalities and the Department of Environmental Protection, a Statewide comprehensive and coordinated erosion and sediment control program to reduce the danger from storm water runoff, to retard nonpoint pollution from sediment and to conserve and protect the land, water, air and other environmental resources of the State."

The measure was not adopted in the first legislative session and was reintroduced by a new sponsor who pressed for action. With the deletion of the State funding provision, it was passed by the Senate without dissenting votes and sent to the General Assembly where minor amendments were made and approval was given without dissenting votes. Returned to the Senate, the bill again was approved without dissent. Considered carefully by the Governor, the bill was finally approved in November of 1975 with the strong support of conservation and environmental groups. At this point it should be noted that much behind the scenes lobbying and educational efforts were exerted throughout the entire process which also had the support of the State Home Builders Association.

Among the basic elements of the law is the requirement for the State Soil Conservation Committee to promulgate technical standards for use throughout the State. Fortunately, the Standards prepared in 1972 were suitable and ready for promulgation in the very short six week period before the law became effective. We are now preparing to promulgate rather extensive revisions and additions to these Standards to reflect experience gained over the years and to encompass the latest state of the art.

The key regulation in the law is that no municipality may grant approval of an application for development for any project until a plan for soil erosion and sediment control has been certified by the soil conservation district. A project is defined as the disturbance of more than 5,000 square feet of land for the accommodation of construction for which the State Uniform Construction Code would require a construction permit. Single family homes not part of a development are exempt. This established the municipality and the soil conservation district as an enforcement team with the initial regulatory contact for the developer made at the municipal level.

For clarification it should be pointed out that no private development can take place in New Jersey without the approval of the municipality. In addition the State Construction Code requires issurance of a municipal construction permit for any public construction initiated by a municipality or county. Therefore all construction, except for a few remaining public agency projects, is controlled by the law.

Upon receipt of complete application for certification of a soil erosion and sediment control plan, the conservation district must respond within thirty days indicating that the plan is (1) certified as meeting the State Standards as submitted; (2) certified with conditions or (3) denied with reasons stated. If no action is taken by the district within thirty days, the plan is automatically certified. The thirty day period may be extended for an additional thirty days by mutual agreement between the district and the developer.

The district is authorized to collect a fee from the applicant to cover the costs of providing services. The district fee schedule must be approved by the State Soil Conservation Committee prior to its implementation and must bear a reasonable relationship to the costs.

Enforcement provisions include the issuance of stop-construction orders by the district or the municipality if a project is not being executed in accordance with the certified control plan. Municipalities may not grant certificates of occupancy unless there has been district verification of compliance with permanent erosion control measures of the plan. The district or the municipality may seek injunctive relief through the courts to prevent violations and persons found in violation of the law may be liable to a penalty of up to $3,000 with each day of continuing violation constituting a distinct and separate offense.

The mechanics of implementation may be of interest. The builder or developer approaches the municipality for project approval. He is referred to the soil conservation district for certification of the required soil erosion and sediment control plan. District personnel receive the plan and appropriate fees. They may provide interpretive assistance to the developer to assist in identifying appropriate control measures. They will not assist directly in the preparation of the plan. Where needed, cooperating resource agencies such as the Soil Conservation Service may be asked to review and comment on the plan. After detailed review, district professional personnel make recommendations to the district governing body which issues certification or denial. Conditions of certification require applicants to notify the district several days in advance of construction and to allow on site inspections at district option.

Where inspection reveals variance from the certified plan, the developer is requested to make necessary modifications.

If cooperation is not received after reasonable notice or warning a stop order may be issued. Upon completion of construction, a report of compliance is issued if the plan has been satisfactorily implemented. The municipality may then grant a certificate of occupancy.

Some statistics on the experiences over the past three and one-half years may be of interest. From January 1, 1976 to June 30, 1979, 6,387 applications have been received. Averaging 10 acres each, these projects have involved approximately 64,000 acres of land to be developed. Sixty-one hundred and seventy-two projects were certified as submitted or with conditions with 221 rejected as inadequate. Over 1½ million dollars have been received in fees to cover costs. The average fee per application is about $200 or about $20 acre. The activity among our 16 districts has ranged from 1,100 applications in the Freehold district to 25 in the Salem district during the 3½ year period.

The development of financial support and program personnel may be of interest. At the outset most of our 16 districts had one full or near full time clerical person and one professional administrative person. These personnel were supported primarily by State funds administered by the State Soil Conservation Committee. Clerical personnel were employed on an hourly basis by the State and State matching funds were provided to support district level employment of the administrative personnel. Additional professional and technical personnel have now been employed directly by the districts bringing field strength to about 50.

Fees received under the program now total about $450,000 per year. State support is approximately $250,000 per year with county government contributions approximately $150,000 annually for a total district level budget of about $850,000 per year. This shows considerable public subsidization of the program with fees supporting a little more than half of the overall district operation. Estimates of districts time spent on the urban erosion control program range from 10% to 90% with an estimated average of 75% statewide.

Program support is also received from cooperating agencies. The SCS will provide engineering review and interpretive assistance in technical matters where needed. We rely heavily upon the SCS to provide training for district technical personnel and to assist with the development and updating of technical Standards. Other resource agencies assist where appropriate such as the State Bureau of Forestry and the Cooperative Extension Service.

The reaction from the controlled public is as may be expected, reluctant but, in general, compliant. Most developers have accepted the erosion requirement and include control plans without coercion. An excellent relationship exists with the State Builders Association and lines of communication with them remain open at all times. The Builders Association provides an advisory member to the State Committee and several builders serve as members of district governing bodies. A few development companies still attempt to avoid the regulation and several municipalities provide less than outstanding cooperation.

Several enforcement actions are currently in process where municipalities have chosen to give the law less than full recognition. Where stop orders have been challenged, court actions have resulted in support of the district. We have found it is frequently necessary to assist the legal profession to raise their levels of understanding of the legislation and the associated problems.

The statistics cited earlier regarding number of projects do not include actions by the exempt municipalities. The home rule option was exercised by 85 municipalities which adopted ordinances meeting the approval of the State Committee. The ordinances were required to incorporate controls at least equivalent to those of the districts. Although the conservation districts have a responsibility to continually monitor the performance of the exempt municipalities no project data has been compiled at this time. Were we to start again, we would not propose the municipal exemption provision.

Our experiences have shown need for some changes and where we could have done better in developing the program. Deficiencies in the legislation appear in the area of State level support, including financial, technical and legal assistance and in the scope of project coverage. Beginning with the latter, there is no control of land disturbances such as clearing and grading which may precede the construction permit stage. Public agency construction other than county and municipal is not regulated although this has been partially resolved through interdepartmental agreements at the State level. An example of this is a requirement by the State Department of Education that local school districts must now have conservation district approval of erosion control plansas one of the many requirements for State approval.

With regard to State level support there is need for more precise identification of a State level appeal process and the availability of legal assistance from the Attorney General. There is further need for the clarification of legal defense and indemnification of district supervisors from tort claims. And there is need for reasonable assurance of maintenance of a basic state technical staff to assure reasonable statewide uniformity and that adequate public accountability exists. In addition there is need for state level monitoring of program effectiveness.

When our urban soil erosion and sediment control program was enacted, we were the thirteenth state in the Nation to take action of this nature. Our law may be the most comprehensive in that it exempts only single family homes and disturbances of less than 5,000 square feet. It may also be one of the few, or the only State law where the soil conservation district has responsibility from start to completion including inspection and enforcement.

This was a large step for our districts. Our more urban district programs changed from very low budget, relatively low accomplishment, primarily educational in nature to very meaningful programs where the statutory objectives are being achieved. They are now preventing and controlling soil erosion and sedimentation, the basic purpose for their creation.

The transition for our district supervisors from a wholly voluntary program to a regulatory one was reasonably smooth. It has given the district supervisors a new sense of purpose and accomplishment. The addition of professional and technical personnel under their direct control has provided new meaning to their jobs. The regulatory function has not changed the traditional philosophy of assistance, cooperation, reasonableness and practicality.

The program has been recognized by the Department of Environmental Protection as an in-place institutional mechanism available to control nonpoint sources of pollution associated with construction. It is also recognized as the first step towards a comprehensive Statewide program of stormwater management. Our districtsand the State Soil Conservation Committee have been designated as management agencies for nonpoint source pollution control in State 208 plans.

As a closing comment directly related to the future of this and other soil conservation district level administered regulatory programs, we believe it is extremely important to develop and maintain technically competent district personnel. Inherent in this is the need for career advancement and upward mobility opportunities for capable employees Unless attention is given to this important factor, districts may be continually faced with the prospect of training new personnel. I believe this is an area where neighboring states and regions should work closely together to mutual advantage.

We in New Jersey appreciate the opportunity to relate to you our experiences. We do not have a perfect program but it is working and accomplishing our goals. While we need to improve, we believe this program is being handled better than most, if not all, other statewide regulatory programs in N.J. Decisions are made at the local level and advice and assistance are always available to the regulated public. We believe that ours is a successful experiment in government regulation and resource management and protection. We have been able to integrate the expertise, authority and necessary functions of State, regional and local government with the continuing and essential assistance and partnership of the federal government through the Soil Conservation Service.

GEORGIA'S APPROACH TO URBAN EROSION AND SEDIMENT CONTROL

Ken Obenauf, Staff Engineer
Georgia Soil and Water Conservation Committee

THE EROSION AND SEDIMENT CONTROL LAW

On April 24, 1975, the Honorable George Busbee, Governor of the State of Georgia, signed into law Act 599, the Erosion and Sedimentation Act of 1975. The Act states: "It is declared to be the policy of this

> State and the intent of this Act to strengthen and extend the present erosion and sediment control activities and programs of this State and to provide for the establishment and implementation of a Statewide comprehensive soil erosion and sediment control program to conserve and protect land, water, air and other resources of the State."

Basically the law requires establishing a permitting program to control "land-disturbing" activities. "Land-disturbing" activities are defined as;

> "Any land change which may result in soil erosion from water or wind and the movements of sediment into state water or onto land within the state including, but not limited to:
>
> 1. clearing
> 2. dredging
> 3. grading
> 4. excavating
> 5. transporting
> 6. filling "

This seems to imply that practically every type of activity would require a permit. The law goes further, however, to list quite a few exemptions.

Land-Disturbing Activity
Does Not Include:

1. Surface mining
2. Granite quarrying
3. Minor land-disturbing activities
4. Construction of single-family residences for owner
5. Agricultural and forestry practices
6. Any project under the technical supervision of the SCS

7. Land change projects with movement of less than 500 cubic yards of soil (If not within 200 feet of a major river)
8. Land change projects with less than 5 acres disturbed (If not within 200 feet of a major river)
9. Projects on federal lands
10. Construction or maintenance by:
    1. Department of Transportation
    2. Georgia Highway Authority
    3. Georgia Tollway Authority
    4. Airport or public utilities under Public Service Commission
    5. Counties
    6. Municipalities
11. Activities started prior to ordinance date (If finished 12 months after ordinance adoption date)

While the law contains many exemptions, the primary purpose is to control major sediment producers, that is, large construction - such as, shopping centers, subdivisions and industrial sites.

Local Ordinances

Act 599 gives the governing authorities of Georgia's 159 counties and 531 incorporated municipalities an option to adopt comprehensive ordinances governing land-disturbing activities within their boundaries. The ordinances must contain technical principles (see table 1) as provided in the law and procedures for issuance of permits. Those governments can strengthen ordinances by eliminating certain exclusions or adding to the technical principles. Municipalities and counties which failed to have in effect a comprehensive erosion and sediment control program on April 24, 1977, are subject to rules and regulations developed by the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources. The Division issues permits, performs inspections and becomes the enforcer of land-disturbing activities until such time as the local authorities adopt an ordinance. EPD also has responsibility for reviewing ordinances adopted by city and county governments to determine compliance with the minimum requirements of the law.

Table 1 - Technical Principles, Section 4, Act 599.

(a) Stripping of vegetation, regrading and other development activities shall be conducted in such a manner so as to minimize erosion.
(b) Cut-fill operations must be kept to a minimum.
(c) Development plans must conform to topography and soil type so as to create the lowest practical erosion potential.
(d) Whenever feasible, natural vegetation shall be retained, protected and supplemented.
(e) The disturbed area and the duration of exposure to erosive elements shall be kept to a practicable minimum.
(f) Disturbed soil shall be stabilized as quickly as practicable.

(g) Temporary vegetation or mulching shall be employed to protect exposed critical areas during development.
(h) Permanent vegetation and structural erosion control measures must be installed as soon as practicable.
(i) To the extent necessary, sediment in run-off water must be trapped by the use of debris basins, sediment basins, silt traps, or similar measures until the disturbed area is stabilized.
(j) Adequate provisions must be provided to minimize damage from surface water to the cut face of excavations or the sloping surfaces of fills.
(k) Cuts and fills may not endanger adjoining property.
(l) Fills may not encroach upon natural water courses or constructed channels in a manner adversely affecting other property owners.
(m) Grading equipment must cross flowing streams by the means of bridges or culverts except when such methods are not feasible and provided, in any case, that such crossings are kept to a minimum.

District Review

One unique characteristic of the Act is the requirement for a Soil and Water Conservation District plan review. The law requires that erosion and sediment control plans for each non-exempt activity be prepared and submitted with application for a permit to the local unit of government. The plans are then forwarded to the appropriate Soil and Water Conservation District for determining the adequacy of the plans.

This requirement for District review was incorporated into the law by the Georgia General Assembly. It was designed to assist units of government which do not staff people qualified to review the plans. The Districts individually proclaimed that high priority will be given to the review of these erosion and sediment control plans. In most cases, the Soil Conservation Service (SCS) of USDA, through a memorandum-of-agreement with the Districts, actually conducts the review of technical plans.

After a thorough analysis of the plans, they are returned to the issuing authority with the district's recommendations. This authority then issues or denies permits. Should a permit be denied because of discrepancies in the plans, such discrepancies must be made apparent to the applicant. The law requires that a permit be issued or denied within a period not to exceed 45 days after the plan and application are submitted. (It should be pointed out that the District review is generally conducted within 5 days. In most cases the review is actually completed the same day the plans are received by the District.)

Another primary reason for the District review requirement concerns cases where local units of government allow the state's Environmental Protection Division to handle the permit program. The District review insures a local review by local people familiar with the local situations and problems.

If a permit is denied, there are appeal procedures in the Act. Any person aggrieved by a decision or order of the permit issuing authority, after exhausting his administrative remedies, has the right to appeal to the Superior Court of the county where such land-disturbing activity is proposed to occur.

ASSISTANCE OFFERED BY THE STATE COMMITTEE

The State Soil and Water Conservation Committee is the administrative and policy making body of Georgia's Soil and Water Conservation Districts. The State Committee's involvement as a result of Act 599 includes, establishing and coordinating procedures for District plan review, advice and consent to rules and regulations adopted for use by EPD, and inform and develop material for use by those involved in erosion and sediment control.

Informational Program

To better inform the citizens of Georgia of the implications and responsibilities of this new law, the State Committee initiated several programs. A series of presentations were made throughout the state explaining the law. Several television appearances were made, and numerous newspaper articles were written and printed. Articles were prepared and sent to professional newsletters, trade publications, and public interest groups.

Model Ordinance

To assist the local city and county governments, a model erosion and sediment control ordinance was written. This model ordinance was subjected to numerous reviews by various professions and organizations. Comments were incorporated from lawyers, engineers, developers and representatives of city and county governments. Distribution of the model ordinance was handled by the Association of County Commissioners of Georgia, the Georgia Municipal Association - as well as Soil and Water Conservation Districts. The State Committee offered assistance to any city or county government interested in adopting an erosion and sediment control program.

Seminars

Three two-day seminars were organized for engineers involved in land-disturbing activities. The seminars consisted of speakers experienced in various aspects of erosion and sediment control, a workshop type approach in developing sample plans, a presentation on assistance offered by various organizations and useful related publications, and presentations and displays of commercially available erosion and sediment control products. Individualized seminars are also conducted statewide upon request by city, county and state agencies.

Manual

Perhaps the most useful form of assistance offered by the State Committee was composing and publishing the Manual for Erosion and Sediment Control in Georgia. The Manual was designed to meet three basic requirements; (1) to be as complete as possible so the user would not have to search from one source of information to another when designing erosion and sediment control plans; (2) to be readable and indexed for use by non-engineers. (Engineers generally design the plans but non-engineers usually enforce the law and, on occasion, must handle the plan review); and (3) to be easy to use and durable.

The Manual was developed from the start with four basic groups of people in mind: (1) the engineer or developer who installs erosion and sediment control practices on the development site, (2) the issuing authority, or governing agency, required to issue land-disturbing permits - either the city or county or Environmental Protection Division, (3) the plan reviewers and (4) the surface mining industry. This last sector did not have standards and specifications yet is required by previous Georgia Law to practice erosion and sediment control.

Fifteen hundred copies were printed followed by an additional 200 copies. One copy was made available to each city, county and SCS district office free of charge. Fifteen dollars per copy is charged of private industries and firms and for additional copies provided to cities or counties. To date, approximately 1100 copies have been distributed. The Manual was accepted as the Best Management Practices Document by both the Construction and Surface Mining 208 Technical Task Forces. (A Technical Task Force approach was used in Georgia to establish the Georgia Water Quality Management Nonpoint Source Control Plan as required by Section 208 of the Federal Clean Water Act.)

Contents of Manual

Chapter 1: The Erosion and Sedimentation Act of 1975.

Chapter 2: Sediment and Erosion Control Processes, Principles and Practices.

An explanation is given on the erosion process and how it is influenced by climate, topography, soils, and vegetative covers. Also included are the six basic design principles for erosion and sediment control. They are:

(1) Fit the activity to the topography and soils,
(2) Minimize the disturbed area and duration of exposure to erosion elements,
(3) Stabilize disturbed areas immediately,
(4) Retain or accommodate runoff,
(5) Retain sediment,
(6) Do not encroach upon watercourses.

These explanations are illustrated by pictures and charts.

One unique addition to this chapter is a removable 21" x 35" chart. The "Uniform Coding System" is a chart of all the practices both structural and vegetative contained in Chapter 6. These practices are displayed for ease of reference by the plan designer and plan reviewer. Each practice has a two letter code which was selected roughly based on the name of the practice. For example, "Di" is diversion and "To" is toe berm. (See Figure 1.)

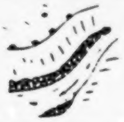
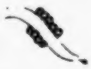
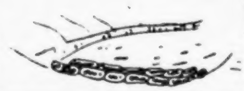
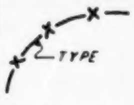
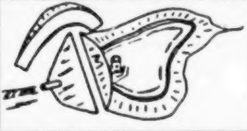
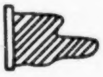
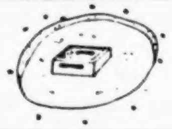
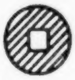
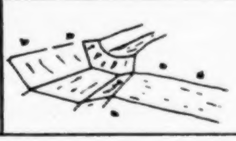
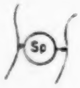
CODE	PRACTICE	DETAIL	MAP SYMBOL	DESCRIPTION
Rp	RIPRAP			Loose rock or similar durable material installed on slopes for protection from erosion caused by water turbulence or high velocities.
Sd1	SEDIMENT BARRIER		 (indicate type)	A barrier to prevent sediment from leaving the construction site. It may be sandbags, bales of straw or hay, brush, logs and poles, gravel, or a sediment fence. The barriers are usually temporary and inexpensive.
Sd2	SEDIMENT BASIN			A basin created by excavation or a dam across a waterway. The surface water runoff is temporarily stored allowing the bulk of the sediment to drop out. The basin is usually temporary but may be designed as a permanent pond or storm water retention device.
Sd3	SEDIMENT TRAP TEMPORARY			An impounding area created by excavating around a storm drain drop inlet. The excavated area will be filled and stabilized on completion of construction activities.
Sp	SPOILBANK SPREADING		 	Disposing of material excavated from a drainage ditch or open channel by spreading the material over adjacent lands.

Figure 1 - Taken from "Uniform Coding System" chart.

Chapter 3: Planning and Plans.
This chapter contains examples on how to prepare plans for obtaining land-disturbing permits.

Chapter 4: Local Programs: Principles and Processes.
Outlined in this chapter are steps local units of government may take to establish and implement their own permitting system.

Chapter 5: Sources of Assistance and Resource Information.
Presented is a list of what assistance is available to the local governments and developers.

Chapter 6: Standards and Specifications for Land-Disturbing and Surface Mining Activities.
This chapter contains the actual engineering standards and specifications for erosion and sediment control practices and structures.

Appendix:
The Appendix, taking up more than one half of the Manual, is the actual "working" section.
Appendix A - Urban Hydrology for Small Watersheds.
Appendix B - Soil Information.
Appendix C - Sediment Basin Design Information.
Appendix D - Diversion Design Information.
Appendix E - Grass Waterway Design Information.
Appendix F - Subsurface Drainage.
Appendix G - Engineering Structures.

Appendix H - Survey Criteria.
Appendix I - Model Ordinance.
Appendix J - Glossary.
References.
Conversion Factors.

Other Publications

The State Committee recently developed a pamphlet, "Georgia's Erosion and Sediment Control Law". This pamphlet basicly describes Act 599, which land-disturbing activities require permits and which activities are exempt from the permitting responsibilities, and who to call for further information.

The newest publication developed by the State Committee is titled "On-Site Erosion Control". It is designed to bridge the gap between plan preparation and physical installation. It is a pocket sized (6" x 3½") ready reference to be carried to the construction site. The contents contain a synopsis of structural and vegetative practices from the Manual for Erosion and Sediment Control in Georgia. Each practice has a separate page with a sketch, short explanation, and design and physical limitations. (See sample page, Figure 2.) The booklet is aimed at an audience of construction engineers, site foremen, equipment operators and site inspectors. The printing of this publication was financed in part through a water quality management technical assistance planning grant from the Environmental Protection Agency through provisions of Section 208 of the Federal Clean Water Act.

Now in the process of development is a directory of contact persons (name, title, department and phone numbers) responsible for the city or county erosion and sediment control program. This directory is being developed to help prospective industries with information on local permit requirements.

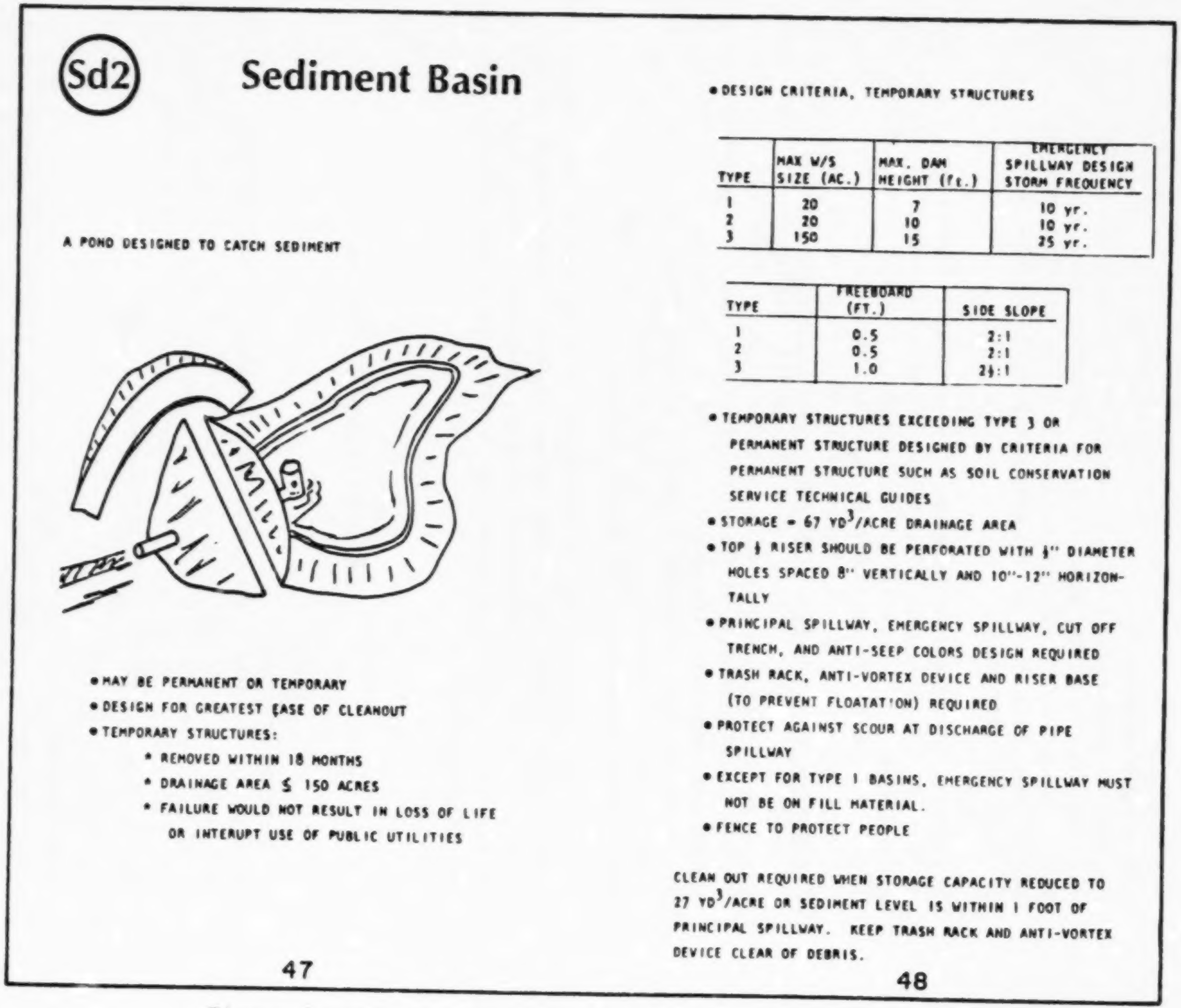
EFFECTIVENESS OF THE LAW

Ordinances Adopted

Ninety two counties have now adopted erosion and sediment control ordinances which have been officially accepted by the Environmental Protection Division. An additional 10 counties have adopted ordinances which are not yet accepted by EPD because of minor modifications needed. EPD has also accepted 150 city ordinances.

Plan Review

Soil and Water Conservation Districts reviewed 768 plans during calendar years 1977 and 1978. In the first half of this year, 392 plans have already been reviewed. The State Conservationist has committed the Soil Conservation Service to meet the District's demands for plan reviews.



Sd2

Sediment Basin

A POND DESIGNED TO CATCH SEDIMENT

- MAY BE PERMANENT OR TEMPORARY
- DESIGN FOR GREATEST EASE OF CLEANOUT
- TEMPORARY STRUCTURES:
  - REMOVED WITHIN 18 MONTHS
  - DRAINAGE AREA ≤ 150 ACRES
  - FAILURE WOULD NOT RESULT IN LOSS OF LIFE OR INTERUPT USE OF PUBLIC UTILITIES

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- DESIGN CRITERIA, TEMPORARY STRUCTURES

TYPE	MAX W/S SIZE (AC.)	MAX. DAM HEIGHT (ft.)	EMERGENCY SPILLWAY DESIGN STORM FREQUENCY
1	20	7	10 yr.
2	20	10	10 yr.
3	150	15	25 yr.

TYPE	FREEBOARD (FT.)	SIDE SLOPE
1	0.5	2:1
2	0.5	2:1
3	1.0	2½:1

- TEMPORARY STRUCTURES EXCEEDING TYPE 3 OR PERMANENT STRUCTURE DESIGNED BY CRITERIA FOR PERMANENT STRUCTURE SUCH AS SOIL CONSERVATION SERVICE TECHNICAL GUIDES
- STORAGE = 67 YD^3/ACRE DRAINAGE AREA
- TOP ½ RISER SHOULD BE PERFORATED WITH ½" DIAMETER HOLES SPACED 8" VERTICALLY AND 10"-12" HORIZONTALLY
- PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, CUT OFF TRENCH, AND ANTI-SEEP COLORS DESIGN REQUIRED
- TRASH RACK, ANTI-VORTEX DEVICE AND RISER BASE (TO PREVENT FLOATATION) REQUIRED
- PROTECT AGAINST SCOUR AT DISCHARGE OF PIPE SPILLWAY
- EXCEPT FOR TYPE 1 BASINS, EMERGENCY SPILLWAY MUST NOT BE ON FILL MATERIAL.
- FENCE TO PROTECT PEOPLE

CLEAN OUT REQUIRED WHEN STORAGE CAPACITY REDUCED TO 27 YD^3/ACRE OR SEDIMENT LEVEL IS WITHIN 1 FOOT OF PRINCIPAL SPILLWAY. KEEP TRASH RACK AND ANTI-VORTEX DEVICE CLEAR OF DEBRIS.

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Figure 2 - Sample Page From "On-Site Erosion Control".

Problems With Program

manpower

Georgia's erosion and sediment control program is not without problems. The Environmental Protection Division, was not given sufficient funds or manpower to handle their permitting and enforcement program responsibilities for the remaining 67 counties and 381 incorporated cities. Personnel and funds had to be taken from other EPD branches to staff this new program.

penalties

From the beginning, enforcement procedures and penalties were purposely omitted from Act 599. It was felt that the local units of government should themselves determine adequate penalties or incentives preventing violations. Unfortunately EPD was also left without specific enforcement procedures. Presently, EPD can only prosecute violations through Georgia's Clean Water Act - a lengthy and often difficult process.

no enforcement

Another problem exists in cities and counties which adopted ordinances. In a few cases, it seems ordinances were adopted mainly to remove permitting responsibilities from the state (EPD). Unfortunately, some are not enforcing ordinances, and, quite frankly, probably do not ever intend to enforce it.

maintenance

Perhaps the most common statewide problem is lack of maintenance of existing erosion and sediment control practices.

Success of Program

In a recent statewide assessment of the erosion and sediment control program, an interesting observation was made. It seems the success of a program is not always based on a severe penalty but rather on the effectiveness of the inspection program. Many units of government were observed to have exceptional programs due to inspectors who were always on top of the situation. In these cases, enforcement was rarely needed and as expected, maintenance problems were also rare.

penalty/incentive

As pointed out earlier, each city or county government made the decision on what type of penalty/incentive program was needed. Perhaps the most effective penalty is a "stop work" order. This type of enforcement procedure seems to work regardless of the size of the project. The most effective incentive seems to be the requirement of performance bonds. Such bonds insure a stabilized construction site even if the company declares bankruptcy.

exemptions

Act 599 admittedly contains a good many exemptions. As is the case with most laws, the final passage of the Act was possible only after a series of compromises. Such an approach has its merits. Now that the program has a solid footing and has proven its successfulness, it can be strengthened as needed. A program is already underway to amend the law, thereby eliminating many of the problems discussed previously.

spin-offs

Act 599 has some positive side effects. For example, the Georgia Department of Transportation, though exempt from Act 599, has shown visible improvements with their own erosion and sediment control program. In one highly urbanized coastal county, the erosion and sediment control plans must be prepared by professional engineers (county requirement). Since engineers are required, they are also used to design storm water drainage systems. The results are new developments which do not add sediment to existing drainage but have adequate drainage systems from the outset.

SUMMARY

Georgia's Erosion and Sedimentation Act became effective April 24, 1975. Its intent is the control of major urban sediment producers. That is, large construction such as shopping centers, subdivisions and industrial sites. The law contains two unique characteristics: First, local units of government are given two options. They can adopt comprehensive programs for erosion and sediment control - or allow permitting and enforcement responsibilities to be handled by the state's Environmental Protection Division. The second unique thing is the requirement for a Soil and Water Conservation District review of all plans for erosion and sediment control. The Districts have accepted this responsibility and are reviewing plans much faster than the time period allowed by the law.

The State Soil and Water Conservation Committee initiated a comprehensive program to assist Georgia citizens with requirements of this relatively new law. Such a program includes printed articles, seminars, a model ordinance, pamphlets and a manual containing engineering standards and specifications.

The Georgia program is not without problems. The problems range from lack of manpower, funds and adequate enforcement procedures for the state EPD to local units failure to enforce ordinances. The most common statewide problem is failure to maintain on-site control structures. This can generally be traced to insufficient inspection programs.

Plans are now being developed to strengthen the law. Amendments will deal with the problems of enforcement and the lack of maintenance/inspection programs.

The most successful permitting programs seem to be based on a strong inspection department. Other successful means of assuming compliance with permit requirements are "stop work" order and posting performance bonds.

In the final analysis, Georgia's urban erosion and sediment control program, when viewed statewide, is lessening soil erosion and preventing sediment damages from construction activities. Present trends indicate an increasing rate of improvement as the program gains momentum.

PLANNING, LOCAL CONTROL, AND STATE SUPPORT: THE KEY TO URBAN EROSION AND SEDIMENT CONTROL IN CALIFORNIA

Edward Craddock
Land and Water Use Analyst
California Department of Conservation
Coordinator of the Soil Resources Protection Program

Since we are here basically to learn, I can share with you the experiences of one of those 31 other states that have no effective urban erosion and sediment control coordination at the state level. In fact, when the explanation was made that various Soil Conservation Boards, Commissions, and Departments perform similar functions depending upon the state. I felt I should tell you: in California, I am the Soil Conservation Board or Soil Conservation Commission. I am the only person at the state level, dealing with soil resources as a primary focus.

Do we have the key to erosion and sediment control in California? In a way, I think we do, although it is now in the formative stages. We have a key with many grooves, that aren't working together effectively; groves that need to be refined and honed so they can fit that lock to open a better approach to erosion and sediment control at the state level.

My objective today is to acquaint you with the extent of the problem in California, to explore some of the current functions and dysfunctions of agencies that are involved in the erosion and sediment control, and to suggest a general element of the strategy to start dealing with this problem.

I think the first problem that we have in California is problem identification. We have not reached a consensus at this point on how severe the problem is, particularly when we look at it in the water quality context. I think most California agencies and entities dealing with soil erosion and sedimentation were looking to the non-point aspect of the 208 planning process to answer some of these questions, and it really didn't.

I would like to share with you an analysis of the water quality context, which came from a report developed by the John Muir Institute for the California Association of Resource Conservation Districts, entitled, Erosion and Sedimentation in California Watersheds: A Study of Institutional Controls. The general observation made in that report, with which I concur, was that the signature of erosion on the land in California is clearly legible, but the impact of sediment on water quality is less so. Unlike many situations, here the cause is a bit more observable than the effect.

However, water quality, not soil conservation or watershed management, is the stated concern of the Section 208 program of the Federal Water Pollution Control Act. The fact that the goals, objectives and programs of 208 are couched primarily in water quality terms, complicates the problem assessment in California, and complicates standard-setting and implementation of non-point pollution control as well. The standards for determining the levels at which sediment becomes a non-point pollution problem, are very difficult to formulate and apply. In California the result is an extraordinary gap between goals and performance. I don't want to leave you with the impression that our resources agency and the departments within it have not made any strides in identifying the problem; I only think a difficulty has arisen from relating it too closely to water quality.

My own department has published three reports over the past decade that I think pretty sufficiently focused the problem and the extent of the problem. The first report was on the impact of urbanization of California foothill lands. California may be different from other states in that severe problems are associated with one to five-acre individual home sites and not solely related to subdivision tracts. These are normally what we term one- to five-acre ranchettes, that are often developed with few controls. Horses often graze the ranchette property down to bare soils. They are a tremendous sediment source. Our report identified this type of subdivision as a primary problem area in the state, and determined that the unimproved roads associated with such subdivisions were a major cause of sedimentation.

Later in the early 70s, our Division of Mines and Geology published an Urban Geology Master Plan for the State of California. That report estimated that erosion and sedimentation; and a commensurate problem in California, that of unstable soils and mass soil movement; potentially could cost the citizens and governments of the state, billions of dollars, in damages before the year 2000. You've probably seen the horror pictures of 200 thousand dollar homes taking a ride down unstable slopes in southern California.

Recently I was involved in an inventory to help analyze, for the legislature, the extent of our soil-related problems in the state. This was something that had not been done at a state-wide level. We examined a multitude of topics ranging from erosion and sedimentation, to sludge disposal on land, to pesticide applications affecting land, in relation to all types of land use.

I want to emphasize that the following figures are probably very conservative ones, because we used the Resource Conservation Districts as our inventory arm, and in many of our urban areas, Resource Conservation Districts do not exist, or are not active. In the Urban land section of this report, we determined that 354,000 acres, or 11% of urban land in the state, was affected to some degree by soil erosion and sedimentation problems. Again the report reemphasized that foothill lands, on the western flank of the Sierra Nevada and some of our coastal mountain ranges, were our primary problem areas, with 20 to 28% of all urban lands affected to some degree by water erosion and sedimentation. A major cause of bare land during those critical erosion periods in California, from November through April, was considered to be the result of development and construction activities.

So I think there's ample evidence that we have a problem in California, a problem that should be dealt with pretty quickly. I will give you some specific examples, but first I would like to give you some background information to acquaint you with the California situation.

First, erosion potential in California. Most of the foothill belt and the coastal ranges are rated severe to very severe, or at a minimum having moderate erosion potential. Many of our major urbanizing areas along the coast; the San Francisco bay area, the north bay counties, a and the Los Angeles area; are in this sensitve environment. The same is true on foothills surrounding central valley. Many areas of severe erosion are associated with soils developed on decomposed granites in the foothill belt and in the Sierra Nevada.

Second, mass soil movement, which cannot really be separated from erosion as a major sediment contributor. The coastal area would also be classified as having moderate to very severe mass movement potential. When you have watershed disturbances which accelerate runoff and streambank erosion, you almost certainly accelerate landslides and other mass soil movements directly into streams.

Third, the tremendous geographic and physiographic diversity found in California. Although there is still alot of the State lacking soil maps, we know we are approcahing 900 soil series, and 2500 soil phases, including textural phases.

Fourth, the wide range of climate in California. We have as much as 100 inches of rainfall in the northeast corner, and as little as two inches in the Colorado desert. Due to these factors, it is difficult to establish a consensus as to the severity of the problem or develop overall comprehensive programs out of Scramento.

I would like to share with you some of the institutional problems found at the local and state levels in California. First I would like to focus on the cities and counties. Some of them already recognize the problem. A recent institutional study by the Association of Bay Area Governments, the seven counties surrounding San Francisco Bay, reported how many counties had established either erosion and sediment control ordinances, had strengthened their existing grading ordinances; or had taken some steps to control erosion and sedimentation in the Bay area. Fifty percent of the counties and municipalities in that area had ceased relying on uniform building code standards, toward more stringent criteria or guidelines for erosion and sediment control. All but one county has now developed a specific ordinance. However, I think this report highlighted an institutional problem that has been mentioned frequently at this Conference: there are so many different approaches and requirements in these ordinances, that it is likely to be confusing and frustrating to developers. A statewide program should develop or at least encourage a consistent and equitable approach.

From our own inventory, we concluded that many of the smaller counties in the state have no expertise or experience in dealing with this problem, and need some kind of state support, either technical, informational, or educational. They just do not have the staff to do the job,and in post-Prop 13 era in California, the prospect is they may have no staff or less staff in the future.

Our statewide study indicated that only 33% of the counties had adopted some specific ordinance to deal with erosion and sedimentation. If you subtract from that the large counties surrounding San Francisco Bay, and the Los Angeles area, you find that few counties have taken steps in relation to foothill problems. Of all counties that reported to us, only about 40% indicated they had enough followup to feel that they could enforce their ordinances. Fully three-quarters of the responding counties desired state support in the form of a model erosion and sediment control ordinance, or technical training workshops.

Foothill counties are growing at a more rapid rate than any other area of California, at rates of ten to twelve percent per year. I will highlight the plight of some of the foothill counties with a short description of two cases.

One is in Tuolumne County, which is the county bordering Yosemite National Park. Tuolumne County had a situation where a subdivision surrounding a small lake was sedimenting into the lake. The citizens only recourse was to file suit through the Attorney General's office, to get a mandated change to the county's general plan requiring a stronger approach to controlling soil erosion and sedimentation in their county. That is still in litigation.

In Mariposa county, there is a one- to five-acre subdivision in the watershed from which their water supply is derived. At present their water supply is undrinkable for four months out of the year, and they are searching frantically for some type of support. I was the first state employee ever to visit the County and attend a County Supervisor's meeting to find out what the situation was. The Chairman of the Board said, "Mr. Craddock, we're so glad to see you here, maybe you and your technical staff can help us out." I said, "You're talking to the technical staff." Fortunately they were at the point where they basically needed only some engineering technical support. The Chairman of the Board commented, "I can't understand it. There are probably busloads of engineers in your Resources Agency. They could ship some out here and nobody would miss them at all." In a way he's correct - I'm sure there are plenty of horses that can be marshalled. For example, I suggested they contact the Department of Transportation to utilize their engineering expertise; but that is too fragmented an approach, and the problem is getting too critical.

As you are well aware, Proposition 13 has affected the funding of many of our counties, and many of our special districts including the Resource Conservation Districts. Some of them are completely unfunded now, and most of them have had their funds cut in half or more due to Proposition 13. The State has been able to provide some funds from state budget supluses. Recently, a new law has been passed in California that indexes the state income tax brackets to inflation, so I think we'll see that the windfall at the state level, and extra funds, will no longer exist in a couple of years. At the same time we have the "Spirit of 13 initiative" on the November ballot, that will put a lid on state government spending. So I don't think a person would have to be too aggressive to convince counties, and the state entities that exist, that it's time to get our act together and work with what we have, instead of working at cross-purposes and building fiefdoms in state government.

I would like to comment about Resource Conservation Districts in California. I fully agree with comments I've heard here, that if you're going to do an effective job done, strong and aggressive conservation districts should be involved at the local level. In California we have a situation where the movement has not been nearly as strong as in most other states. At present, only 70% of the private lands of the state, and most of the urbanized areas of the state, are not covered by districts. Our inventory indicated that in only 20% of the cases, were RCDs frequently relied on by counties to help in solving soil-related problems. Now this is a gap that has to be closed, if we are going to have our performance come close to our goals and objectives.

We have another institution operating in California; a relatively autonomous Governor's Office of Planning and Research. This office does not have regulatory authority, but is relied upon to insure that all counties have general plans developed under the planning law of the state. Some of these plans, as I indicated earlier, have come under review and criticism, and suits have been filed through the Attorney General's office to strengthen them. Some of these plans treat soils, soil erosion and sedimentation very cavalierly, while others do an excellent job. I feel that the Office of Planning and Research should encourage more consistency into general plans, and develop better guidelines for the treatment of soil resources in general, including erosion and sedimentation. Their latest thrust is to develop a foothills policy strategy for the state. I think it is imperative for them to be involved in any strategy to get urban erosion and sedimentation identified as a major concern in California.

The entity in the state having the most power and authority, the State Water Resources Control Board, has done very little to address urban erosion and sedimentation problems. They undertook a very detailed study of two developments around Lake Tahoe. One showed almost no acceleration of erosion over background levels, in a very well-designed and planned development called North Star, at the north end of the lake (a combination of condominiums, summer recreation, and ski area development). At the same time they studied a poorly-designed subdivision on the west side of the lake, where they measured erosion rates a thousand times over background levels. At this date, ten years after development, we still have rates a hundred times greater than background erosion levels. The Board has really not followed up on this report in order to bring erosion and sedimentation to the forefront as a major environmental issue. The enforcement arm for water pollution control in California resides in Regional Water Quality Control Boards. These Boards have only recently moved into the area of urban erosion and sedimentation, by amending their Regional Water Quality Plan.

My own department's activity in this area has been specifically through the development, in conjunction with the Environmental Protection Agency, of an Erosion and Sediment Control Handbook, that outlines the planning procedures, provides a model ordinance, and the general mitigation measures that may be applied. However, with a one-man program, I basically mail the Handbook out with little followup. There's been tremendous interest in the Handbook itself, we've distributed almost five thousand copies, and we've received complimentary reports as far as cost-savings obtained by using some of the methods and procedures in it. It was used by Tuolumne county Board of Supervisors and their planning commission in trying to write an ordinance for the county, something that has not borne fruit yet. My department somehow has to develop an outreach program with this Handbook. We will not expand much further and neither will other state agencies; therefore, a coordinated effort must be developed.

I hope I have given you the impression that things are not organized well in California at present, but I think my department must function as a catalyst to get other agencies and entities moving. As a direct result of this conference, after learning about the existing and proposed institutions in other states, I feel that on my return to California, I must encourage the development of a Task Force on Urban Erosion and Sedimentation at the state level, comprised of the State Water Resources Control Board, the Governor's Office of Planning and Research, my own Department, and the California Association of Resource Conservation Districts. I think this would serve two purposes: to provide a unified focus from the state level; and to give impetus for these institutional mechanisms to start to work together in California. When it comes to soil surveys, we have state and federal agencies cooperating effectively with the State Soil Survey Committee coordinating activities very well, in an interagency concept and framework. I am confident a similar approach can work in California in regards to urban erosion and sediment control.

Also when I return, I'm going to emphasize that our own department, in coorperation with these other entities, the private sector, and federal agencies, engage in a series of workshops and seminars modeled after this conference. The purpose of these workshops would be to highlight local concerns; to illustrate successful local programs to other counties that are having problems; to acquaint the public with the use of, and availability of, state support, and to provide publications or other technical support. I think that currently erosion and sediment control programs in California are a long way from reaching first base, but I hope that by the time of the second National Conference, we will be rounding first and on our way to second.

CONSERVATION PROBLEMS
- FROM THE LOCAL PERSPECTIVE -

Thomas P. Kujawa
Milwaukee (Wisconsin)
County Supervisor
24th District

Before I begin sharing my thoughts and viewpoints regarding the various problems urban counties are experiencing in the area of soil and water conservation, I must first apologize for not being in attendance for the entire conference.

Ironically, my reason or justification for lack of full participation in this conference serves as an added testimony to one of the many problems facing urban counties regarding conservation, and that would be in establishing one's priorities (we are in the midst of our budget and I am a member of the Finance Committee).

I represent Milwaukee County, which is located in Southeastern Wisconsin. We have a population of approximately 1 million people settled in 19 municipalities. Milwaukee County is typically urban, with all areas incorporated, and very much aware of their "home rule" powers.

The average member of our County Board, I would imagine, is much like the average member of any large, totally urban county.

We are city born and bred, with little or no concept of sound conservation practices. Most of us have served in some capacity as local politicians, and come from an educational background that has prepared us for business, law or perhaps the field of education.

We have not had the benefit of practical day-to-day encounters with the land, such as those of you with farm and agricultural backgrounds.

Our prime concerns in government have been in establishing sound financial practices in government, encouraging business and industry, combating excessive costs in the area of social welfare programs, and encouraging a firm tax base.

In the day-to-day operation of our county, we are confronted by one crisis after another, either real or imagined. Unfortunately, in the eyes of an urban supervisor, conservation matters rarely, if ever, reach crisis proportion and therefore, rate a very low priority.

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There is little knowledge or concern about the cause and effect of wetlands to erosion and flooding problems. We tend to look at wetlands as a cause of mosquitoes and source of odors. An urban solution, therefore, would be to fill in and commercially develop the area.

We solve too many problems with concrete and black-top, never realizing the surface water run-off problems that we create at lower elevations.

Within our school systems, little or nothing is taught about sound soil and water management practices. Too many in a city atmosphere believe this is a matter for the rural curriculum.

As far as committee assignments and duties are concerned in urban county government, Extension and Agricultural Committees, per se, have little appeal, and are certainly not coveted assignments.

In urban counties with their incorporated municipalities, we traditionally see local politicians selfishly concerned with only their locality. They refuse to accept county planning, looking at this planning as an invasion of their home rule authority. The local perception is often, "Land must be developed," and the good neighbor policy sometimes, oftentimes, in fact, becomes secondary or non-existent.

The development of a sub-division has many times been known to cause erosion and flooding problems for the neighboring community depending upon its topography and locale.

The individual landowner has little or no incentive to keep certain lands and marshes in common trust. There are few, if any, tax breaks, and only encouragement to develop land and turn a profit.

Petty jealousies and short-sightedness continually stand in the way of county-wide and regional planning. There is a decided lack of state legislation that would allow for long-range conservation programs. We have a woeful lack of the needed monetary incentives and inducements to allow for wetlands and green areas.

Air quality and noise pollution, proper disposal of organic wastes and proper land use are fast becoming problems of major proportions in the urban county, and most are finding out they have not adequately prepared to meet thees problems.

Sub-dividers and developers must be forced to submit realistic plans and safeguards to avoid these serious problems. The environmental impact statement must be made a part of the local picture, as well as the federal. Laws must be enforced and fines levied to protect us from the unscrupulous and unknowing.

Education in the elementary and secondary schools must encourage greater awareness in our environment.

"Good Neighbor Policies" must be formulated by adjacent communities, and communication is of paramount importance.

For those of you who represent emerging urban counties or rural counties in transition, learn from our mistakes. Enact the legislation you will need, allow the state to help set up sensible guidelines, listen to the experts in the area of soil and water conservation. Look toward tomorrow and the world of your children and grandchildren. What we destroy today may never be replaced.

SUMMARY AND EVALUATION, FROM A NATIONAL PERSPECTIVE

Robert Thronson
Environmental Engineer, Implementation Branch
U. S. Environmental Protection Agency
Washington, D.C.

My task in participating at this National conference on Urban Erosion and Sediment Control is to provide a summary of the organization and content of the Conference and evaluate it from a National perspective concerning water pollution and other environmental degradation. In order to accomplish this, I feel that I must provide you first with some information concerning EPA's philosophy and concerns with respect to the effective control of construction-related nonpoint sources of pollution.

EPA's responsibilities under the Clean Water Act (P.L. 95-217) involves encouraging State and Areawide Water Quality Management Agencies in the development and implementation of plans for controlling, or preventing, nonpoint sources of pollution such as those resulting from construction activities. By this Act, Congress placed primary responsibility for the management of nonpoint source pollution in the hands of the States and local governments. This is as it should be as the States and localities are better able to identify their own problems and develop effective control mechanisms and programs than is the Federal government.

We want to see the State and local governmental organizations getting more and more into the business of really facing up to these issues. Plans for solving the nonpoint source as well as other pollution problems are being developed, and they should be implemented, through a political process in which both citizens and their elected officials --- not technical experts or appointed officials --- make all the basic choices and decisions.

Construction is a broad category covering the alteration and development of land for a different use, including the installation of structures on th land. The types of projects within this category generally have two common characteristics, namely; (1) they involve soil disturbance, resulting in modification of the physical, chemical, and biological properties of the land; and (2) they are short lived in the sense that the "construction phase" closes when the development and building activities are completed. There are many types of projects that fall within the construction category. They generally can be classified into the following sub-categories:

Land Development
Transportation and Communication Networks
Water Resources Facilities

Sediment resulting from erosion of disturbed soils is one of the principal pollutants originating from construction. It includes solid mineral and organic materials which are transported by runoff water, wind, ice, and the effect of gravity.

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It is extremely difficult to assess, with any reasonable accuracy, the magnitude and extent of pollutant discharge from construction areas. This is due to the fact that the runoff from each site varies tremendously depending on the intensity and duration of rainfall; topography, geology, and soil types occurring in the area; areal extent of disturbed soil; type of construction involved; character of vegetative cover; and other local conditions.

Most, if not all, construction activities which involve disturbance of surface soils or underlying geologic materials result in the generation of nonpoint source pollutants. Surface water runoff will transport these materials from the site unless extreme care is taken to implement control measures which contain them within the area of development. If effective control is not provided, it is not necessary to determine _if_ pollutant runoff has occured but only to assess the magnitude and extent of the problems resulting.

The cost of controlling, or preventing, erosion and sediment problems resulting from construction activities is considered by EPA to be less than the cost for correcting the environmental damages that affect downstream areas. Also, the cost of correcting these erosion and sediment damages usually is unjustifiably transferred to the tax payer rather than to those benefitting from the projects or developments. As a result, EPA is strongly encouraging the use of regulatory programs by State and local government groups which emphasize pollution prevention rather than subsequent correction of environmental damages.

The technical capability of controlling erosion and sediment deposition from construction is available. The development and availability of effective erosion and sediment control measures, however, is not enough. They must be applied, through a regulatory program, on construction sites where the runoff of sediments has the potential to cause pollution. There has been a reluctance, in many areas of the country, for State and local governments to establish and enforce construction-related sediment control requirements. This probably results from varied reasons. One is that each agency feels that its area of jurisdiction stands to receive no benefits from carrying out the program. This is true to some extent as the downstream area, where the sediment ends up, receives maximum benefits with the minimum effort exerted. The first agency, however, must realize that it benefits from controls exerted by all those further upstream. Each agency also benefits by the reduction of sediment loads deposited locally from the activities involved.

Another reason for agency reluctance probably results from the prevalent feeling that sediment is a naturally-occurring material that has been moving from topographically higher areas to lower areas for millions of years. This also is true - however, the sediment we are interested in controlling results from man's activities. It often exceeds the natural sediment losses from an area by several thousand times.

A third reason for avoiding the development of needed controls probably results from various groups that have been conducting the activities that create the sediment problems. They pressure governmental agencies into believing that "this is the way things have always been done". Particularly in construction activities, the philosophy often is expounded to this effect, "Let us finish the job and then we'll provide for sediment control". By the time construction has been completed most of the sediment has already left the site and pollution is occurring.

EPA, in its Water Quality Management program activities under Section 208 of the Clean Water Act, is stressing public participation in the planning and implementation of control programs at the State and local governmental level. The 208 program has been a significant catalyst for promoting involvement by citizens and elected officials in the basic planning and decision-making process that is so necessary to make and sustain tough environmental decisions.

We are committed to the building of public awareness and understanding of the nonpoint source pollution problems resulting from such activities as construction and the mechanisms available for prevention, or control. Education and involvement is essential for developing an understanding of local problems and engendering support for effective control programs. The 208 program has been a lead in promoting public involvement --- in encouraging citizen interest, creativity, and initiation in the decision making process.

Builders and developers as well as their engineering consultants also must become involved in helping to structure and implement effective programs. They should participate by contributing to the development of an effective control program and in the definition and evaluation of effective processes, procedures, and methods for controlling erosion and the runoff of sediments. Builders and developers probably are more directly involved with the effects of control than any other group except the downstream recipients of excess sediment loads.

Conclusion

There is a definite need to make people and organizations aware of how nonpoint source pollution resulting from construction activities can affect conditions around them and to provide information on methods available for controlling it at the source areas themsleves.

Effective control requires vigorous and aggressive action by all levels of government with the complete cooperation and support of concerned members of the community. The technical capability of control is largely available; however, the development and adoption of institutional measures and the preparation of organizational procedures for applying this technical knowlede is lacking and urgently needed. Cooperation between governmental groups concerned with control, and others which provide the technical "know how", is essential to obtain a meaningful program. State and local organizations and their officials must acknowledge their share of the responsibility which often is diffused among several agencies. These agencies effectiveness many times is inadequate because they react to damage rather than undertaking action to prevent the environmental pollution.

Technical and professional people involved with conducting construction activities should become bold enough to express themselves against what they know to be pollution-causing practices regardless of the conflicting views of their associates and others. They should be in the forefront in the development of innovative new control practices. Technical people often hide behind the "security blanket" of professionalism, by limiting their discussion groups to other professionals only, when they would do better by exposing themselves to public opinion and their critics. Environmental concerns are not a passing fancy but are here to stay and many professional people are flunking the course by following and not leading in the pollution control efforts.

Evaluation of the Conference

First of all, I must compliment the Conference Staff on the excellent job they have done. They provided for an exciting initiation of the Conference on the first day, through Mr. Kirkpatrick's and Mr. Beal's contrasting viewpoints. They indicated that the Homebuilders, those conducting the construction activities, are concerned regarding practicality, flexibility, common sense, and cost effectiveness in regulations; and the regulatory agencies are attempting to achieve water quality and environmental goals with minimum effects on the construction industry - this conflict continued through the entire program and I think it was constructive and useful. Both sides are right to some extent and I think that neither has complete faith in the other's philosophy.

When one considers control programs or mechanisms, there were several other concerns that kept raising their inquisitive heads throughout the entire conference discussion as speakers expressed their views. I've heard most of them before and consider them to be valid when erosion and sediment runoff programs are involved. They are:

1. Multiple agencies with overlapping responsibilities are involved in control and confuse the developer.

2. Regulations may specify procedures rather than performance standards to achieve required control results - many do not agree this is the way to go - and I'm afraid I concur.

3. Engineering design criteria and concepts often are outdated and conflict with the intent of erosion and sediment control management practices - changes are drasticially needed.

The costs of erosion and sediment control to developers, and subsequently to homeowners, were discussed, but no one seemed to agree on their validity. Indicators were presented that they may be fairly low and may even benefit the developers in not having to regrade slopes, clean out storm drains, recover equipment, and the like. Costs of control to the regulatory authority were not really considered, although data are available to indicate that a local program can be made self sufficient through plan review, inspection, and other fees graduated to consider the complexibility of the development.

In my opinion, enough data were presented at the Conference to expose all of the potential problems to be encountered, but few suggestions, or mechanisms, provided for their solution. Communication, coordination, and cooperative action between builders, regulatory agencies, the public, and other needs were brought up from time to time but never clearly emphasized. No regulatory program can be initiated and conducted successfully without such action. Public knowledge regarding construction - related problems, proposed solutions, costs to the developer and taxpayer, and other related information is essential to achieve builder-regulator agency cooperation and public support for needed programs. The development, evaluation, and periodic revision of Best Management Practices for control should accomplished through a multi-desciplinary approach where engineers, soils experts, hydrologists, biologists, agronomists, and the concerned public can present their viewpoints. They should be site-specific and flexible enough to enable innovative techniques to be developed.

Greater clarification is needed regarding how local, state, and other organizations should interface in control programs. Mr. Church, attorney from the University of Wisconsin, suggested that the State act to enable local government to pass ordinances and he provided a model as a suggestion. Control programs, to be effective, must involve cooperative action between local government, the state and the federal government. Each must provide the other with support, exchange of needed information, technical advise, and perhaps financial help. It is an important issue, as any State, when considering development of a control program, must determine how it is to be implemented at the local level.

A weak point in the Conference involves participants. The dialogue and conflicting viewpoints between developers and regulatory speakers was a highlight in the program, but wider range of participants and viewpoints should be included: consulting engineers, the Associated General Contractors, League of Women Voters, environmental groups, State legislators, County Board of Supervisors, and the like.

A criticism concerning the Conference involves the use of concurrent sessions. I found it difficult to attend a representative group of the papers that would enable me to evaluate the conference as a whole.

Now that the Conference is concluding, I think that attendees and participants should carefully consider what they have learned and ask themselves "where do we go from here." Have you attended merely to discuss mutual problems with peer groups of planners, engineers, and developers - with no further action in mind? If so, the Conference is a failure, as similar activities have been conducted many times in the past. If you are action oriented, however, and intend to work for initiating actions in your State for flexible and effective control then I think it will be considered a success.

We all recognize now, that construction activities carried out in a careless, haphazard manner can create tremendous environmental problems. Also we know that technical and institutional measures for control are available. Many states and local organizations are implementing them. Good regulations are really not aimed at making the construction industry carry out unnecessary actions. They should provide the developer with support, cooperation, guidance, other aid. Regulations are aimed principally at the careless, ignorant, or, as one person politely put it, "green" developer that creates most of the problems. He is in minority, I'm sure, but he gives the entire industry a "black eye" and the environment indigestion.

ABERCROMBIE, Billy R.
P.O. Box 2890
Washington, DC
Soil Conservationist
U.S.D.A.-Soil Cons. Service

AICHINGER, Clifton
550 Capitol Square Building
St. Paul, MN
Critical Areas Coordinator
State of Minnesota

AKELEY, Roger P.
1211 Bydding Road
Ann Arbor, MI 48103
Technical Coordinator, Southeast
Michigan Council of Governments

ANDERSON, Phyllis
Box 13
Newton, NJ 07860
District Manager
Sussex City, SCD

AULT, James E.
320 Washington Avenue South
Hopkins, MN 55343
Hydraulics Engineer
Hennepin County

AYERS, Mark
702 P.O. Building
St. Paul, MN
Hydrologist
U.S. Geological Survey

BAKER, Helen
Afton, MN 55001
Member
Planning Commission

BAKER, John T.
4601 Hammersley
Madison, WI 53711
State Resource Conservationist
Soil Conservation Service

BAUER, Lyle
P.O. Box 158
Harper, Kansas 67058
President, National Association
of Conservation Districts

BEAL, Frank
Director, Illinois Institute for
Natural Resources, Chicago, Illinois

BEDNAR, Jeff
City Hall
Blaine, MN 55434
Engineering Design Coordinator
City of Blaine

BENTLEY, Allen C.
P.O. Box 108
Hammond, WI 54015
Ass't Construction Engineer
St. Croix County Hwy. Dept.

BERG, Norman
Administrator, Soil Conservation
Service, U.S. Department of Agriculture, Washington, D.C.

BERNTSEN, Dale
3161 Maple Grove Road
Duluth, MN 55811
City Council
City of Hermantown

BIRKHOLZ, James R.
1827 N. St. Paul Road
St. Paul, MN 55109
Conservation Specialist
Ramsey Soil & Water Cons. District

BISHOP, Robert D.
1405 Luisa Street
Santa Fe, NM 87501
208 Coordinator
Soil and Water Conservation Div.

BLAND, James K.
Financial Management Branch
Chicago, IL 60604
Environmental Prot. Specialist
U.S. Environmental Prot. Agency

BODIN, Arvid T.
2215 W. Old Shakopee Road
Bloomington, MN 55431
Land Surveyor
City of Bloomington

BOHRER, Larry D.
St. Paul, MN
T.K.D.A.

BONUCCELLI, Hugo A.
Chief, Environmental Systems
Engineering Section, North
Virginia Planning District
Commission, Fall's Church, VI

BRADY, James
President, Majestic Construction
Company, Cincinnati, Ohio

BREZINSKY, William
6875 Highway #65
Minneapolis, MN 55432
Engineer
Suburban Engineering

BRITT, Harlen K.
Box 27687
Raleigh, North Carolina 27611
Sedimentation Control Engineer
N.C. Dept. of Nat'l Resources
and Community Development

BROWN, Ralph L.
P.O. Box 108
Hammond, WI 54015
Highway Commissioner
St. Croix County Highway Dept.

BURNS, Paul
100 Sibley Street
Hastings, MN
City Planner
City of Hastings

BYSLMA, David
Chippewa County Court House
Chippewa Falls, WI 54729
Zoning Administrator
Wis. Assoc. of County Code Admin.

CHRISTENSEN, Brian R.
Towns Edge Shopping Center
Farmington, MN 55024
District Coordinator
Dakota Co. Soil & Water Cons. Dist.

CHRISTENSON, Charles W.
Box 85
Baldwin, WI 54002
County Conservationist
St. Croix County SWCD

CHURCH, William L.
Madison, Wisconsin
Professor of Law
University of Wisconsin

CLAPP, Ginny
Box 756
New Ulm, MN 56073
Area Hydrologist
MN Dept. of Natural Resources

COHN, Charlotte W.
444 Lafayette Road
St. Paul, MN
Hydrologist-Environmental Review
Dept. of Natural Resources

COLBERT, Thomas A.
3795 Pilot Knob Road
Eagan, MN 55122
Director of Public Works
City of Eagan

COLEMAN, Wendy Blake
2200 Churchill Road
Springfield, IL 62706
Environmental Specialist
Illinois, EPA

COLIN, Peter
444 Lafayette Road
St. Paul, MN 55101
Street Surface Water Hydrologist
Dept. of Natural Resources

COX, John
2600 Blair Stone Road
Tallahassee, FL 32301
Environment Specialist
Florida Dept. Environ. Reg.

CRADDOCK. Edward
Sacramento, California
Land and Water Use Analyst
Calif. Dept. of Conservation

CROOKS, Malcolm
P.O. Box 297
Solebury, PA 18963
N.E. Regional Representative
NACD

CUMMINGS, George A.
Cincinnati, Ohio
District Conservationist
SCS, U.S. Dept. of Agriculture

CURTIS, Warren C.
St. Paul, MN
State Resource Conservation
U.S. Soil Cons. Service

DAHL, Gerald E.
Frisco, Colorado
Regional Counsel, Northwest
Colorado Council of Governments

DANIELSON, James E.
750 So. Plaza Drive
Mendota Heights, MN
Director of Public Works
City of Mendota Heights

DAVIS, Paul E.
1935 West Count Road B2
Roseville, MN 55113
Chief, Planning Section
Minn. Pollution Control Agency

DAY, Gary E.
Blacksburg, Virginia
Assistant Professor of Architec.
College of Arch. & Urban Studies
Poly. Institute & State University

DE GROOT, Jon V.
316 N. Robert Street
St. Paul, MN
Assistant State Conservation
USDA Soil Conservation Service

DENEEN, Marylyn
St. Paul, MN
Supervisor, Ramsey SWCD
Member, Urban Committee & NACD

DONAGHUE, David
Middleton, Wisconsin
City Engineer/Director of
Public Works, Middleton

DOUGAN, Arnold E.
Conservation District
Two Harbors, MN 55616
Conservation Specialist
Lake County Soil and Water

DOWNING, William L.
St. Paul, MN
Professor, Hamline University
Urban Committee, Minnesota
Association of SWCD

DUESTERHAUS, Richard L.
Minneapolis, MN
Assistant Administrator, USDA

DUMOVLIN, Pierre-Paul
201 Cremazie East
Montreal, Canada
Engineer, Government-Quebec

ELIAS, James G.
1380 Frost Avenue
Maplewood, MN 55109
Engineering Technician
City of Maplewood

ELMORE, Thomas L.
Frisco, Colorado
Water Quality Management
Coordinator, NW Colorado
Council of Governments

ETTESVOLD, Clarence
Morris, MN 56267
Member, MN Soil & Water BD.

FEIST, William
Middleton, Wisconsin
Research Chemist, Alderman,
Member Planning Commission

FELDMAN, Jay H.
15th and M St. N.W.
Washington, D.C.
Assistant Director, Land Use &
Dev. - Nat'l Ass'n of Home
Builders, Washington, D.C.

FELDSIEN, Lawrence F.
1925 Oakcrest Avenue
Roseville, MN 55113
BIO Technical Engineering

FERGUSON, Donald H.
Duluth, MN 55804
Supervisor, S. St. Louis SWCD

FERREN, Donald G.
6159 Upper 46th Street N.
St. Paul, MN 55109
USDA - Soil Conservation Service

FILIPPI, James D.
1003 East Cliff Road
Burnsville, MN 55337
President, Filippi & Associates

FINNEY, Perry M.
1935 W. County Road B2
Roseville, MN 55113
Planner
MN Pollution Control Agency

FISCHER, Alfred N.
6040 Earl Browne Tower
Brooklyn Center, MN 55430
Area Conservationist
Soil Conservation Service

FLITTER, Michael J.
Box 388
Grand Rapids, MN
Board Respresentative
Minnesota SWCB

FODERBERG, Leon
Wallace Building
Des Moines, IA 50319
Resource Conservationist
Dept. of Soil Conservation

FOOTE, Lawrence E.
Transportation Building
St. Paul, MN
Section Manager Officer
Minnesota DOT

FORSLUND, Charlotte
2401 Highway 10
Mounds View, MN 55112
Councilmember
City of Mounds View

FRANZEN, Michael D.
City Hall - 9150 Central Avenue
Blaine, MN
Planning Coordinator
City of Blaine

FREUND, Adrian P.
RM 14 - City/County Building
Madison, WI 53709
Environmental Resources Plan
Dane County Regional Planning

FUHR, Alison D.
Minneapolis, MN 55455
Member, MN Soil & Water
Conservation Board

GAHM, Thomas
200 Federal Building
St. Paul, MN 55101
Soil Conservation Service

GARNER, Mary M.
1015 Vermont Avenue N.W.
Washington, DC 20037
Legal consultant
N.A.C.D.

GEBHARDT, Ronald P.
1675 Hicks Road - Suite E
Rogging Meadows, IL 60008
District Conservationist
U.S. Soil Conservation Service

GENDRON, Jean-Paul
201 Cremazie East
Montreal, Canada
Engineer, Environmental
Protection Services

GENZLINGER, Vern
320 Washington Avenue So.
Hopkins, MN
Sr. Professor Engineer
Hennepin Co. Public Works

GEWIRTH, Marcella
230 S. Dearborn 5WW4
Chicago, IL
Env. Prof. Specialist
U.S. EPA

GIEFER, Janet M.
Lilydale, MN 55118
Committee Member
Lilydale Planning Committee

GOETTEMOELLER, Roger L.
Columbus, Ohio
Deputy Chief, Poll. Abatement
Division of Soil & Water Districts
Ohio Dept. of Natural Resources

GREINER, William H.
7515 N.E. Ankeny Road
Ankeny, IA 50021
Executive Vice President
Soil Conservation Soc. of America

GRIGG, Neil S.
Raleigh, North Carolina
Assistant Secretary for No. Carolina Dept. of Natural Resources
and Community Development

GUNDRUM, Gary
711 N. Bridge Street
Chippewa Falls, WI 54729
Chippewa County Conservation
Chippewa County SWCD

HAGMAN, Brenda B.
Madison, Wisconsin
Environmental Specialist
WI Dept. of Natural Resources

HAIDER, Kenneth G.
1380 Frost Avenue
Maplewood, MN 55109
Assistant City Engineer
City of Maplewood

HALSEY, Clifton
16 Soil Science Building
St. Paul, MN 55708
Extension Conservationist
University of Minnesota

HANSON, Lowell D.
301 Soil Science
Minneapolis, MN 55455
Soils Ext. Specialist
University of Minnesota

HARNACK, Ronald D.
Space Center Building
St. Paul, MN 55101
Administrative Hydrologist
MN DNR - Division of Waters

HAYES, Chuck K.
1935 W. County Road B2
Roseville, MN 55113
Planner
MN Pollution Control Agency

HEIKEL, Brandt
Duluth, MN 55802
Soil Scientist/Envir. Planning
St Louis Co. Planning Zone

HENDRICKSON, Harold R.
2395 W. Washington Avenue
West Bend, WI
Board Representative
Wis. Board of S.W.L.D.

HICKOK, Eugene A.
Washington D.C.
Agricultural Engineer, Engineering
Division, SCS, Washington D.C.

HIGHFILL, Richard E.
Agricultural Engineer, Engineering
Division, Soil Conservation
Service, Washington D.C.

HOBAN, Tom
Wisconsin Board of Soil and
Water Conservation

HOLMES, Norman
Cheyenne, WY 82001
Supervisor
Frontier Conservation District

HOWARD, Bill
1380 Frost Avenue
Maplewood, MN 55109
Planning Commissioner
City of Maplewood

HURST, William D.
67 Kingsway Avenue
Manitoba, Canada, R3M062
Canadian Representative
Am. Public Works Association

IMERMAN, Sheryl K.
1815 University Avenue
Madison, WI
Soil & Water Conservation
Specialist, BSWCD

ISBERG, Gunnar C.
Minneapolis, Minnesota
President, Isberg, Riesenberg.
Chelseth & Associates, Inc.

ISENSEE, James H.
City Hall, Red Wing, MN
Assistant City Engineer
City of Red Wing

JENSEN, Marie
7 Hillside Court
Northfield, MN 55057
City Council Member
City of Northfield

JENSEN, Steven
Bldg. #1, RM 10 - 2033 S. State
Salt Lake City, UT
Assistant Director
Salt Lake County Water Quality

JIWANI, Mahedi A.
250 N. Central Avenue
Wayzata, MN
Engineer, Hennepin Soil & Water
Conservation District

JOHNSON, Daniel P.
6875 Highway #65
Minneapolis, MN 55432
Engineer, Suburban Engineering

JOHNSON, Gregg
300 Metro Square Building
St. Paul, MN 55101
Local Assistance Planner
Metropolitan Council

JOHNSON, Jean M.
8950 Eden Prairie Road
Eden Prairie, MN 55344
Asst. Planner
City of Eden Prairie

JOHNSON, Jim C.
1400 38th Street
Sioux City, IA
Vice-President, Carl Johnson
Land Development

JOHNSON, John C.
7601 Kentucky Avenue No.
Minneapolis, MN 55428
Project Engineer
Kirkham Michael and Associates,Inc.

JOHNSON, Leonard C.
1815 University Avenue
Madison, WI 53706
Program Chairman
Wis. Board of Soil & Water C.D.

JOHNSON, Michael L.
14600 Minnetonka Boulevard
Minnetonka, MN 55343

JOHNSON, Neil M.
5800 85th Avenue North
Brooklyn Park, MN 55443
Director of Public Works
City of Brooklyn Park

KEEFE, Michael
Planning Commission
Collinsville, IL 62234
Environmental Planner III
S.W. ILL. Metro & Regional

KENDZIORSKI, David B.
Planning commission
Waukasha, WI 53186
Senior Water Quality Planner
Southeastern Wis. Regional

KIRKPATRICK, George Jr.
Gainesville, Florida
President, Kirkpatrick
Builders, Inc., Gainesville

KLEMENHAGEN, Larry
Rochester, MN
Operational Supervisor
Olmstead County

KLUEGEL, Rand
Room 101- Capitol Square
St. Paul, MN 55101
Environmental Analyst
MN State Planning Agency

KNAEBLE, Peter
6875 Highway 65 N.E.
Minneapolis, MN 55432
Civil Engineering
Suburban Engineering

KOEHLER, Dan
14900 61st Street North
Stillwater, MN 55082
Planner, Washington Co. Planning

KOUSMANN, Conrad
Conservation Department
Stillwater, MN 55082
Washington SWCD

KUJAWA, Thomas P.
901 N. 9th Street - Room 201
Milwaukee, WI 53233
Supervisor
Milw. Co. Board of Supervisors

KWIATKOWSKI, Chet
3161 Maple Grove Road
Duluth, MN 55811
Chairman Planning & Zoning
City of Hermantown

LAKE, James E.
1025 Vermont Avenue N.W.
Washington, D.C.
Program Specialist
Nat'l Association of Conservation

LANG, Boris S.
Crofton, Maryland
President, Crofton Properties, Inc.

LARSON, Greg
1260 Dorland Road
Maplewood, MN 55119
Program Specialist, Minn. SWCB

LAYER, Robert W.
2200 N. Seminary
Woodstock, IL 60098
Staff Engineer
Mc Henry Co. Regional Planning

LATIMER, George
347 City Hall
Mayor, City of St. Paul
Minnesota

LAUDENSLAGER, Richard E.
Wernersville, Pennsylvania
Soils Engineer, Dept. of Envir.
Resources, Bureau of Soil & Water
Conservation, State Cons. Comm.

LEE, Warren M.
300 120th Street N.E.
Redmond, WA
Area Conservationist
Soil Conservation Service

LEHMANN, Richard
Madison, Wisconsin
Associate Professor, Dept. of
Governmental Affairs,
University of Wisconsin-Extension

LEIDER, MARK J.
Court House
Sheboygan, WI 53081
County Planning Director
CTY. Planning & Resource Dept.

LENTHE, Charles
5800 85th Avenue North
Brooklyn Park, MN 55443
Assistant City Engineer
City of Brooklyn Park

LEWIS, Jeffrey R.
New Ulm, MN
Area Hydrologist
Minnesota DNR

LIVINGSTON, Eric
2600 Blair Stone Road
Tallahassee, FL 32301
Environmental Specialist
Fla. Dept. Environ. Reg.

LOKKESMOE, Kent
1200 Warner Road
St. Paul, MN 55106
Regional Hydrologist
MN DNR Waters

LUECHT, Dale W.
230 S. Dearborn
Chicago, IL
Chief-MN/WIS. WQM Section
USEPA - Water Division

LUNDBERG, Marilyn D.
600 American Center Building
St. Paul, MN 55101
Executive Secretary
Southern MN River Basin Board

LUNDQUIST, Dwight
Towns Edge Shopping Center
Farmington, MN 55024
Supervisor
Dakota County SWCD

LYBERGER, Ron D.
1935 West County Road B2
Roseville, MN 55113
Planner
Minn. Pollution Control Agency

MAC GILLIVRAY, Donald J.
1602 4th Street S.E.
Rochester, MN
Design Engineer
City of Rochester

MACE, Richard
Waukesha, Wisconsin
Assistant Planning Director
Waukesha Co. Park & Planning Com.

MADIGAN, Thomas
590 40th Avenue N.E.
Columbia Heights, MN 55421
Assistant City Engineer,
City of Columbia Heights

MAJOR, Harry M.
200 Federal Building
St. Paul, MN 55101
State Conservationist, USDA
Soil Conservation Service

MALAND, James R.
14600 Minnetonka Blvd.
Minnetonka, MN 55343
Engineering Assistant
City of Minnetonka

MARCH, Rick
RM 228 - Federal Building
Rapid City, South Dakota
Soil Conservation Service

MARTIN, James S.
Box 32414
Charlotte, NC 28232
Engineer
Celanese Fibers Marketing Co.

MAY, Peter H.
142 Emerson Hall - Cornell Univ.
Ithaca, NY
RCA Program Assistant
N.Y.S. Soil & Water Cons. Comm.

MC KELLIPS, Allen Lee
14600 Minnetonka Boulevard
Minnetonka, MN 55343
Engineering Technician
City of Minnetonka

MC LOUD, Philip R.
830 E. Main Street
Richmond, VA 23219
Hydraulic Engineer
VA Soil & Water Cons. Comm.

MELSTAD, James
Dept. of Health & Env. Science
Helena, MT 59601
Sanitary Engineer
State of Montana

MILLER, Doug
8003 Silas Creek Parkway
Winston-Salem, NC 27106
NC Dept. of Resources

MOELLER, Mark K.
City Hall Fourth & Lafayette
Winona, MN 55987
Senior Planner
City of Winona

MOLDENHAUER, W. C.
Agronomy Dept. - Purdue University
Lafayette, IN
Research Leader
U.S.D.A. - SEA - AR

MOON, Louise P.
Wallace Building
Des Moines, IA 50312
Committee Member
Iowa Soil conservation

MORGAN, Larry M.
1408 Pioneer Building
St. Paul, MN 55101
Project Manager
T.K.D.A. Inc.

MORRISON, Darrel G.
Madison, Wisconsin
Professor and Chairman, Dept.
of Landscape Architecture
University of Wisconsin

MULLER, Terry
5800 85th Avenue North
Brooklyn Park, MN 55443
Project Engineer
City of Brooklyn Park

NELSON, Jeffrey W.
2401 Highway 10
Mounds View, MN 55112
City Administrator
City of Mounds View

NELSON, Thomas
CIN Place of Chippewa City
Hammond, WI
Ass't Zoning Administrator
St. Croix City Zoning

NEWMARK, Joan F.
Watershed District St. Paul, MN
Manager
Ramsey-Washington Metro

NIELSEN, Jeffrey D.
Box 756 Highway 15 South
New Ulm, MN 56073
S.W.C.B. - Representative
Soil & Water Conservation BD.

NUNNALLY, Nelson R.
Charlotte, North Carolina
Professor, Dept. of Geography and
Earth Sciences, University of NC

NYLUND, David
424 Trapelo Road
Waltham, MA 02154
New. Eng. Div. Corps of Eng.

OBENAUF, Ken
Athens, Georgia
Staff Engineer, Erosion & Sediment
Control Specialist, Georgia State
Soil & Water Conservation Committee

OBERTS, Gary L.
St. Paul, MInnesota
Senior Environmental Planner
Metro Council, Twin Cities Area

O'NEILL, Charles W.
P.O. Box 4128
Tumwater, WA 98501
President, W.A.C.D.

OEMICHEN, William P.
200 Federal Building
St. Paul, MN
Ass't State Conservationist
Soil Conservation Service

OLSON, Alan
P.O. Box 66
Crystal Bay, MN 55323
Village Planner, City of Orono

OLSON, David L.
8950 Eden Prairie Road
Eden Prairie, MN 55344
Engineering Technician
City of Eden Prairie

OLSON, Leonard
100 Sibley Street
Hastings, MN
Public Works Director
City of Hastings

OLSON, Patricia
Box 10G - Centennial Building
Minneapolis, MN 55155
Land Use Hydrologist
Dept. of Natural Resources

OSCANYAN, Paul
Rockville, Maryland
Consultant

OTTERSON, Peter H.
Dept. of Natural Resources
Grand Rapids, MN 55744
Area Hydrologist
State Of Minnesota

OWEN, Dave
401 Townes Road
Wayzata, MN 55391
Site Designer - Landplan Inc.

PAYNE, H. E.
111 7th Street N.E.
Rochester, MN 55901
C.H.B. - The Kruse Company

PEDERSEN, Steven W.
600 American Center Building
St. Paul, MN 55101
Alternate Commissioner GLBC
Water Planning Board

Participants

PENDOWSKI, Jim
Div. of Water Pollution Center
Marion, IL 62959
Regional Coordinator
Illinois, E.P.A.

PERKINS, Calvin J.
2nd Floor - 253 Route 211 East
Middletown, NY 10940
Area Conservationist
Ulster Co. Savings Bank

PERSAUD, Deo
1st Clair Avenue West
Toronto, Ontario, Canada
Marine & Construction Engineer
Ministry of Environment

PETERSON, Bruce A.
6875 Highway #65 N.E.
Minneapolis, MN 55432
District Engineer
Suburban Engineering

PETERSON, David
2300 Silver Creek Road N.E.
Rochester, MN 55901
Board Representative
MN Soil & Water Conservation Board

PETERSON, John W.
EPA HDQ. 401 "M" Street S.W.
Washington, DC 20460
Soil Conservationist
EPA SCS Detail

PFAHLER, David
Pierre, South Dakota
Environmental Specialist
Dept. of Water & Natural Resources

PICKRELL, Stoddard M., Jr.
P.O. Box 1269
Alachua, FL 32615
Administrative Assistant
Soil & Water Conservation

PILE, Deborah R.
1935 West County Road B2
Roseville, MN 55113
Planner
Minn. Pollution Control Agency

POCREVA, Robert
Planning Committee
Collinsville, IL 62234
Engineer
Southwestern IL. Metro & Reg.

POLLARD, Ben
20 State Capitol
Oklahoma City, OK 73105
Planning Assistant
Oklahoma Conservation Comm.

POND, Dennis
Department of Natural Resources
St. Paul, MN 55155
Erosion Control Specialist
Soil & Water Conservation Board

PRESTIN, Steve
Space Center Building
St. Paul, MN 55101
Shoreland Mgmt. Hydrologist

PYLE, Ken
538 Memory Lane
Carmel, IN 46032

RACE, Samuel R.
P.O. Box 1888
Trenton, NJ
Coordinator, N.J. Dept. of Agri.
N.J. Department of Agriculture

READ, David
1200 South Broadway Suite 140
Rochester, MN 55901
Pollution Control Specialist
Minn. Pollution Control Agency

REED, Kenneth D.
444 Lafayette Road
St. Paul, MN 55101
Principal Hydrologist
Dept. of Natural Resources

REINERT, Vernon F.
Department of Natural Resources
St. Paul, MN 55155
Executive Director
Soil and Water Conservation Bd.

RICHARDSON, Brandt F.
St. Paul, Minnesota
Senior Hydrologist,
Minn. Water Planning Board

RICHARDSON, Jim
8950 Eden Prairie Road
Eden Prairies, MN 55344
Engineer Technician
City of Eden Prairie

RIPPKE, Jon A.
219 North Main Street
Mankato, MN 56001
Project/Design Engineer
Bolton and Menk Inc.

ROBERTS, Don
230 S. Deerborne
Chicago, IL 60604
Water Resources Planner
U.S. E.P.A.

ROBINETTE, James A.
8830 207th Street W.
Lakeville, MN
Public Works Director
City of Lakeville

ROMAN, Les
Court House
Morristown, NJ
Director,
Morris County SCD

ROOS, Amos
1935 West County Road B2
Roseville, MN 55113
Engineer
Minn. Pollution Control Agency

RUDRUD, Ronald L.
2215 W. Old Shakopee Road
Bloomington, MN 55431
City engineer
City of Bloomington

SAHABANDU, A. G.
Downsview, Ontario, Canada
Project Engineer, The Metro
Toronto & Region Cons. Authority

SAVAGE, Eugene C.
1815 University Avenue
Madison, WI
Executive Secretary
Bed S.W.C.D.

SCHEVENIUS, John
Minneapolis, MN 55419
Staff Engineer
General Mills Inc.

SCHILLING, Joel
1935 W. County Road B2
Roseville, MN
Coord., Clean Lakes Grant Prog.
Minn. Pollution Control Agency

SCHOLL, Harold E.
16118 Jerald Road
Laurel, MD 20810
State Resource Conservationist
USDA-SCS

SCHULTE, Gerald J.
103 Fairview Drive
South Sioux City, NE 68776
Vice President
Schulte Construction Inc.

SCHULTZ, Marc A.
916 N. East Avenue
Madison, WI
Resource Agent
University Extension

SCILLEY, F. Maynard
Room 200 - Federal Building
St. Paul, MN
State Soil Scientist
U.S.D.A. - SCS

SEELEY, Gerard, Jr.
Richmond, Virginia
Chief Engineer, Virginia Soil &
Water Conservation Commission

SETTLES, Joel C.
250 N. Central Avenue
Wayzata, MN
Dist. Limnology
Hennepin Soil & Water Conservation

SIME, Harley A.
11819 Stoughton Avenue
Tomah, WI 54660
Surveyors
H.A. Sime and Associates

SNYDER, Ella M.
35 S. Grady Way Suite B
Benton, WA 98055
Manager
King County Soil Conservation

SOLBERG, Curt
City Hall - Box 34
Red Wing, MN 55066

City of Red Wing

SONNENBERG, David J.
City Hall
River Falls, WI 54022
City Engineer
City of River Falls

SPURRIER, H.R.
129 E. First Avenue
Shakopee, MN 55379
City Engineer
City of Shakopee

STATSER, Richard L.
2221 Devine Street -Suite 222
Columbia, SC 29205
Chief Planning & Developing
Land Resources

STEFANIAK, Philip A.
1616 Humboldt Avenue
West St. Paul, MN 55118
Director of Public Works
City of West St. Paul

STEWART, David E.
P.O. Box 4184
Madison, WI 53715

SWECKER, George R.
830 E. Main Street - Suite 800
Richmond, VA 23219
Soil & Water Conservation Spec.
VA Soil & Water Cons. Commission

SWEENEY, John R.
14600 Minnetonka Boulevard
Minnetonka, MN 55343
Assistant City Engineer
City of Minnetonka

TAUER, Wayne
6875 Highway #65 N.E.
Minneapolis, MN 55432
Land Planner
Suburban Engineering

TAYLOR, Mary Jane
Box 34
Red Wing, MN 55066
City Council President
City of Red Wing

THOMAS, Doug
Conservation Department
Stillwater, MN 55082
District Resource Conservationist
Washington Co. Soil & Water

THOMPSON, Karen
2500 Shadywood Road - Box 90
Navarre, MN 55392
Information Specialist
Freshwater Society

TOMPKINS, Marian A.
Wallace Bldg. - 900 E. Grand
Des Moines, IA 50319
Environmental Specialist
IA Dept. of Environ. Quality

THRONSON, Robert
Washington, D.C.
Environmental Engineer
Implementation Branch, U.S.
Environmental Protection Agency

TRIGGER, Grant R.
Detroit, Michigan
Environmental Engineer, Southeast
MI Council of Governments

URBAN, Donald
384 Ventura Club Drive
Roselle, IL 60172
Planning Committee, Region V
U.S. Environ. Protection Agency

VANCE, Lawrence G.
Wallace State Office Guilding
Des Moines, IA 50319
Director
Iowa Dept. of Soil Conservation

VICTOR, Timothy J.
County-City Building
Steven Point, WI 54481
District Resource Conserv.
Portage County SWCD

WAGNER, Lloyd
Box 44 Centennial Building
St. Paul, MN 55155
Environmental Studies Forester
Dept. of Natural Resources

WALKER, Susan J.
830 E. Main Street - Suite 800
Richmond, VA 23219
Soil & Water Cons. Specialist
Virginia Soil & Water Cons. Com.

WEIBERG, Erling
555 Wabasha Street
St. Paul, MN 55102
Executive Secretary
MN Water Resources Board

WELLS, John R.
600 American Center
St. Paul, MN 55101
Senior Hydrologist
MN Water Planning Board

WENDLAND, Stan
1827 No. St. Paul Road
Maplewood, MN 55109
District Conservationist
Soil Conservation Service

WERNICKE, Werner
Cultural Affairs P.O. Box 4340
St. Thomas, VI
Director-Div. of Coastal Mgmt.
Department of Conservation

WHITMAN, Elizabeth
Afton, MN 55001
Vice-Chairman
Mission of Afton

WIDUTA, Stephen
1200 Warner Road
St. Paul, MN 55106
Board Representative
Minnesota SWCB

WIEB, Jacob
Afton, MN
  Planning Commission
  City of Afton

WILLET, Gerald L.
St. Paul, MN 55155
  Minnesota State Senator

WILLIAMS, Robert E.
1025 Vermont Avenue
Washington, D.C.
  Director of Special Projects
  N.A.C.D.

YOUNGE, Michael J.
519 4th Avenue S.W.
Rochester, MN 55901
  Younge Bros. Construction Co.

ZITZMANN, Warren T.
Arlington, VA 22207
  Community Planner, U.S. Soil
  Conservation Service, Wash. D.C.